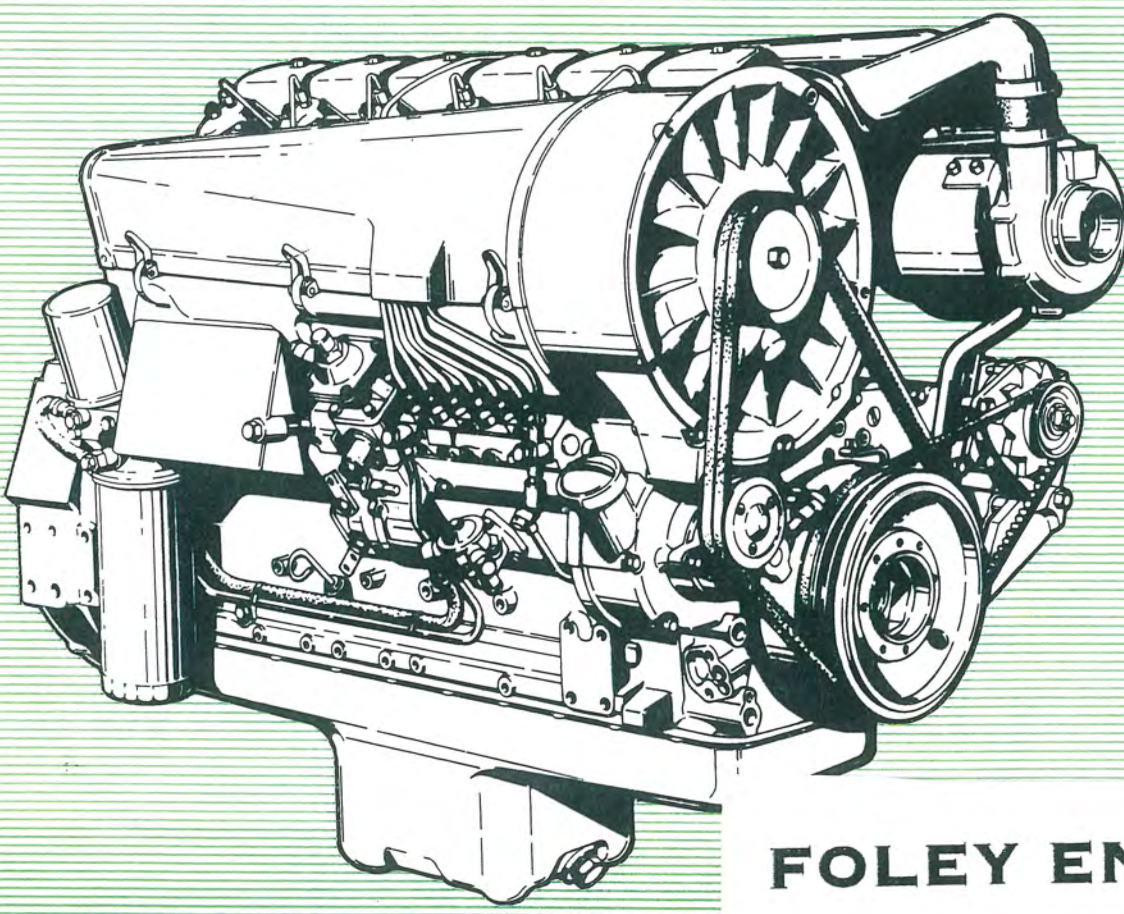
KHD DEUTZ

291 1842 DC

6/1991

B/FL911/912/W/913/C



WORKSHOP MANUAL
for
Air-cooled DEUTZ Diesel Engines

FOLEY ENGINES
SINCE 1916
MARINE & INDUSTRIAL

B/FL911/912/W/913/C

Printed material No.	291 1842
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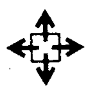
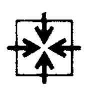
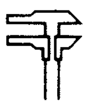
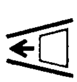
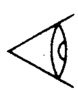
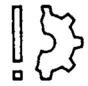
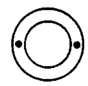
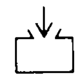
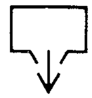
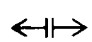
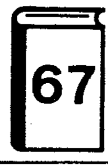
- Remember that such engine components as springs, clips, snap rings, etc. involve the risk of injury if not handled with care.

- Engine overhauls must be based on the relevant engine duty schedule - as defined by the equipment manufacturer. For conversions only such parts should be used which DEUTZ develops and supplies specifically for this purpose.

Key to Symbols

	**Disassembly** of assembly groups
	**Reassemble** to form assembly group
	**Remove** obstructing parts
	**Reinstall – Remount** parts which had obstructed disassembly
	**Attention! Important notice!**
	**Check – Adjust** e. g. torque, dimensions, pressures, etc.
	**Special tool**
	**Note direction of installation**
	**Visual inspection**
	**Possibly still serviceable** Renew if necessary
	**Renew at each reassembly**
	**Unlock – Lock** e. g. split pin, locking plate, etc.
	**Lock – Adhere** e. g. with liquid sealant

	**Guard against personal injury** Indication of hazard
	**Guard against material damage** Damage to parts
	**Prop up – Support – Hold**
	**Oil**
	**Grease**
	**Mark** before disassembly, observe marks when reassembling
	**Balance** Eliminate any imbalance
	**Filling – Topping up – Refilling** e. g. oil, cooling water, etc.
	**Drain off** e. g. oil, cooling water, etc.
	**Loosen – Release** e. g. loosening a clamping device
	**Tighten – Clamp** e. g. tightening a clamping device
	**Vent**
	**Machining process**
 67	See Technical Data (For inst. 67 as indication of the line)

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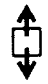
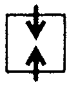
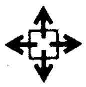
	**Disassembly** of assembly groups
	**Reassemble** to form assembly group
	**Remove** obstructing parts
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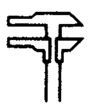	**Check – Adjust** e. g. torque, dimensions, pressures, etc.
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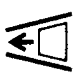
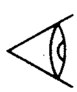
	**Note direction of installation**
	**Visual inspection**
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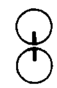
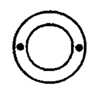
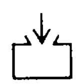
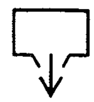
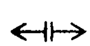
	**Mark** before disassembly, observe marks when reassembling
	**Balance** Eliminate any imbalance
	**Filling – Topping up – Refilling** e. g. oil, cooling water, etc.
	**Drain off** e. g. oil, cooling water, etc.
	**Loosen – Release** e. g. loosening a clamping device
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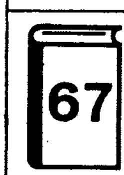
	See Technical Data (For inst. 67 as indication of the line)

Contents

Table of Contents

1. SPECIFICATION DATA

000 General engine data

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G	BF4/6L 913/C/T
001	Engine weight w/o starter and generator approx. kg *	F2L = 235 F3L = 270 F4L = 300 F5L = 380 F6L = 410	440	F3L 913 = 277 F3L 913G = 280 F4L 913 = 307 F6L 913 = 430	BF4L 913 = 350 BF4L 913T = 335 BF6L 913 = 485 BF6L 913T = 470 BF6L 913C = 510
002	Engine swept volume cm3	F2L = 1885 F3L = 2827 F4L = 3770 F5L = 4712 B/F6L = 5655		F3L 913/G = 3064 B/F4L 913/T = 4086 B/F6L 913/T/C = 6128	
003	Bore mm	100		102	
004	Stroke mm	120		125	
005	Direction of rotation	Auf Schwungrad gesehen links When facing flywheel left counter-clockwise Vu sur volant à gauche Mirándose sobre el volante izquierda			
006	Rated speed max. rpm	F2L = 2500 F3-6L = 3000 F3-6L 912W = 2800	3000	F3L 913G = 2300 F3L 913 = 2500 F4-6L 913 = 2800	BF4L 913/T = 2500 BF6L 913 = 2800 BF6L 913C = 2500 BF6L 913T = 2500
007	Minimum idle speed rpm	F2L = 750 - 800 650 - 700			
008	Working cycle	Viertakt-Diesel Four-stroke diesel Diesel 4 temps Diesel a 4 tiempos			

* approximate weight dependent on the scope of supply

000 General engine data

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G	BF4/6L 913/C/T
009	Combustion system	FL 912W = 2-stage combustion system		B/FL 912/913/G/C/T = Direkt injection	
010	Compression ration	FL 912 = 17 : 1 FL 912W = 19 : 1	15,5 : 1	FL 913 = 17,0 : 1 F3L 913G = 19,6 : 1	15,5 : 1 1) 17 : 1
011	Compression pressure bar	FL 912 = 20 - 28 FL 912W = 25 - 30	22 - 25	26 - 30	24 - 28
012	Firing order	F2L = 2 - 1 F3L = 1 - 2 - 3 B/F4L = 1 - 3 - 4 - 2		F5L = 1 - 2 - 4 - 5 - 3 B/F6L = 1 - 5 - 3 - 6 - 2 - 4	
020	Dimensions of engine incl. standard flywheel				
021	Max. length mm	F2L = 458 F3L = 595 F4L = 725 F5L = 855 F6L = 985	995	F3L 913 = 595 F3L 913G = 590 F4L 913 = 725 F6L 913 = 998	BF4L = 726 BF6L = 1012
022	Max. width mm	F2L = 625 F3-6L = 665	695	F3L 913G = 629 F3-6L 913 = 665	BF4L 913/T = 665 BF6L 913 = 695 BF6L 913T = 665 BF6L 913C = 711
023	Max. height mm	F2L = 772 F3L = 813 F4L = 798 F5L = 838 F6L = 808	810	F3L 913 = 813 F3L 913G = 742 F4L 913 = 798 F6L 913 = 873	BF4L913/T = 837 BF6L913/T = 875 8F6L913C = 990

1) Engine with optimized exhaust emission levels

100 Fuel injection system

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
110	Fuel injection pump				
111	Make, model	F2L 912/W = Deutz Bosch A F3-6L912/W = Bosch A	Bosch A		BF4L913 = Bosch A BF6L 913/C = Bosch A Bosch MW
112	Min. pres. that must be attained with abt. 5 rot. of crankshaft bar	300			
113	Pressure for testing tightness of relief valve bar	150, drop to 140 in a minute permiss.			
120	Governor				
121	Make, model	F2L = Deutz Bosch B/F3-6L = Bosch	RS, RSV, RQ, RQV		

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
130	Injection nozzle				
131	Make, model	Bosch FL912 = DLLA 149S774 FL912W = DNOSD165	Bosch DLLA 149S775 DLLA 149S576 1)	Bosch DLLA 149S774 F3L913G = DLLA146S910	Bosch DLLA 149S775 DLLA 150P131 2)
132	Opening pres. (checking injector for re-use) bar	FL 912 = 175^{+8} FL 912W = 115^{+8}	175^{+8}	175^{+8} 220^{+8} 5)	175^{+8} 245^{+8} 2) 240^{+8} 3) 225^{+8} 4) 220^{+8} 5)
133	Opening pressure (new condition) bar	FL 912 = 180^{+8} FL 912W = 120^{+8}	180^{+8}	180^{+8} 225^{+8} 5)	180^{+8} 250^{+8} 2) 245^{+8} 3) 230^{+8} 4) 225^{+8} 5)

1) Cylinder head with cast-iron plate

2) Engine for Bundeswehr (Federal German Army) BF6L913 - 124kW / 2650min^{-1}

3) Engine with optimized exhaust emissionlevels BF6L913

4) Combine harvester engine

5) F3L 913G / tractor - BF6L 913 - DX 7.10, DX 6.50

100 Fuel injection system

	English
140	Commencement of fuel delivery
141	Static w/o advance / retard unit
142	Static with advance / retard unit

140	Version	Speed 1/min	Timming delivery Timming ∡	Del. Timing in deg. C/A BTDC ± 1° *)

FL912

	Version	Speed 1/min	Timming delivery	F2L912 1)	F2L912 2)	F3L912	F4L912	F5L912	F6L912	BF6L912
141		≤ 1800		32	26	26		29		
		1801 - 2300		32	30	-		-		
		2301 - 2500		38	32					-
		1801 - 2499				28		30		
		2500 - 2649				30		32		
		2650 - 3000				32		35		
		1800 - 2500	-	-		-		-		32
	Fendt	2000				24	-			
		2300				24	24	-		-
		2400				24	-			
	Tractor	1801-2300		32	30	-	-			
		≤ 2399				28		30		
		≥ 2400		-		30	-	30		-
	AC (40kW)	2500				34	-	-		
142		≤ 3000	12°			22		25		-
	EPA (74kW)	2800	"	-		-		20	-	
		2500 - 2800	"			-		-		24

FL912W

	Version	Speed 1/min	Timming delivery	F3L912W	F4L912W	F5L912W	F6L912W	
141		≤ 1800		20		22		
		1801 - 2300	-	22			24	
		2301 - 2800		23			25	
	Tractor (43kW)	2300		-	22	-	-	
142		≤2300	6°	15			17	
		≥2301	"	18		20		

FL913G

	Version	Speed 1/min	Timming delivery	F3L913G	
141		2000 - 2300	-	21^{+1}	

*) = Unless otherwise specified.
1) = Deutz Injection pump
2) = Bosch Injection pump
AC = Atlas Copco (application in South-Africa)
EPA = US Environmental Protection Agency Certificate

	Variante	Drehzahl 1/min	Spritzversteller Verstell ∡	Förderbeginn in ° KW vor OT ± 1° *)
	Version	Speed 1/min	Timming delivery Timming ∡	Del. Timing in deg. C/A BTDC ± 1° *)
140	Variante	Vitesse de rotation	Correcteur d'avance	Avance à l' injection en degrés vil. avant PMH ± 1° *)
	Variante	rpm	graduar de avance de inyección graduación	Comienzo de alimentación en grados de giro del cigüñal ante PMS ± 1° *)

FL913

	Plunger ⌀			F3L913 8,5	F4L913 8,5	F4L913 8,0	F6L913 8,5	F6L913 8,0
141		≤ 1800		24	25	26	28	29
		1801 - 2299		26				
		≥ 2300		26				
		1801 - 2499			27	28	29	30
		2500 - 2649			29	30	31	32
		2650 - 2800			-	32	-	35
	ST (36kW)	1500			-	27	-	-
	AC (89kW)	2500			-	-	-	34
	Fendt	2200		23	23	-	-	-
	(42kW)	2300		22	-	-	-	-
	(44kW)	2400		22	-	-	-	-
	Tractor	≤ 2300		26	27	-	29	-
		2301-2400		24	27	-	29	-
		2401-2500		22	-	-	-	-
142	Fendt(59kW)	2400	6°	-	22	-	-	-
		≤ 2800	12°		20	21	-	24
	BW (78kW)	2800	"		-	-	19_{-1}	-
	IM (85kW)	2500	"		-	-	21	-

BFL913T

				BF4L913T	BF6L913T
141		≤ 1800		-	26
		1801 - 2300		27	28
		2301 - 2500		26	30
142		1500 - 2500	6°	-	26

*) = soweit nicht anders angegeben
ST = Strüver Aggregat
AC = Atlas Copco (Süd-Afrika Einsatz)
BW = Bundeswehrmotor
IM = Iveco Magirus

*) = Unless otherwise specified.
ST = Strüver set
AC = Atlas Copco (application in South-Africa)
BW = engine used at German Armed Forces
IM = Iveco Magirus

*) = sauf indication contraire
ST = groupe Strüver
AC = Atlas Copco (exploitation en Afrique du Sud
BW = moteur de la Bundeswehr (armée allemande)
IM = Iveco Magirus

*) = si no indica otra cosa
ST = grupo Strüver
AC = Atlas Copco (aplicación en Africa del Sur)
BW = motor para el ejecito de la RFA
IM = Iveco Magirus

	Version	Speed 1/min	Timming delivery Timming ∡	Del. Timing in deg. C/A BTDC ± 1° *)		
140						
	BFL913			BF4L913	BF6L913	
141		≤ 1799		24	-	
		1800 - 2200		26	-	
		2201 - 2500		28	-	
		1500 - 1999		-	28	
		2000 - 2300		-	30	
		2301 - 2800		-	32	
	ST (74kW)	1500		-	28	
	(112kW)	2300		-	32	Plunger ⌀8,5mm, Vorhub 1,9mm
	(118kW)	2300		-	32	Entlastungsvolumen 70mm³
	Tractor	2200		-	28	
		2300		27	28	
		2400		-	30	
142		2800	6°	-	26	
	IM/BW (124kW)	2650	"	-	12_{-1}	(MW - Pumpe)
	IM/BW (124kW)	2650	"	-	26^{+2}	(A - Pumpe)
	IM/Fzg (104kW)	2500	"	-	23^{+1}	(ATL 3 LEP 289 A 16.2) **)
	Fzg	2500	"	-	22^{+1}	(ATL K27-2964 MNA 15.2) **)
	EPA(118kW)	2500	"	-	20_{-1}	
		1500 - 2800	12°	-	24	

	Version	Speed 1/min	Timming delivery Timming ∡	BF6L913C	
	BFL913C			BF6L913C	
141		≤ 1800		26	
		1801 - 2300		28	
		2301 - 2500		30	
	O&K	2300		17_{-1}	(MW - Pumpe)
142		1500 - 2500	6°	26	
	EPA(140kW)	2500	"	20_{-1}	
	Po (125kW)	2800	"	26	

*) = Unless otherwise specified.
**) = ECE49 -20%
EPA = US Environmental Protection Agency Certificate
ST = Strüver set
Po = Poclain engine
IM = Iveco Magirus
IM/FWFzg = IM / fire-fighting vehicle
Fzg. = Automotive engine
BW = engine used at German Armed Forces
O&K = Orenstein & Koppel
Vorhub = Prelift
Entlastungsvolumen = Retraction volume
Pumpe = Pump

100 Fuel injection system

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
150	Advance / retard unit				
151	Adjustg. range degrs.crank angle	see 142			
152	Commencing at rpm	1200			
153	Ending at rpm	2800			

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
200	Cylinder head				
210	Valve guide				
211	Valve guide Outer dia. mm	$15^{+0{,}056}_{+0{,}045}$			
212	Valve guide bore in cyl. head mm	$15^{+0{,}011}$			
213	Valve guide (pressed in) Inner dia. mm	$8^{+0{,}015}$			
220	Valve seat insert				
221	Valve seat insert Outer dia. Inlet mm	$45{,}66_{-0{,}02}$			
222	Valve seat insert Outer dia. Exhaust mm	$40{,}16_{-0{,}02}$			

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
223	Valve seat insert bore Inlet mm	$45,5^{+0,025}$			
224	Valve seat insert bore Exhaust mm	$40^{+0,025}$			
230	Valve				
231	Valve stem dia. Inlet mm	$7,96_{-0,015}$			
232	Valve stem dia. Exhaust mm	$7,94_{-0,02}$			
233	Valve stem clearance Inlet standard mm	0,04 - 0,07			
234	Valve stem clearance Inlet Wear limit mm	0,15			

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
235	Valve stem clearance Exhaust standard mm	0,06 - 0,095			
236	Valve stem clearance Exhaust Wear limit mm	0,2			
237	Valve head Ø Inlet mm	43 ±0,1			
238	Valve head Ø Exhaust mm	37 ±0,1			
239	Valve seat width Inlet mm	$1{,}5^{+0{,}5}$			$1{,}5^{+0{,}5}$ $2{,}0^{+0{,}5}$ 1)
240	Valve seat width Exhaust mm	$1{,}5^{+0{,}5}$			
241	Seat angle Inlet deg.	45			45 30 2)

1) At 30° seat angel

2) Engine with optimized exhaust emission levels and Engine with high power

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
242	Seat angle Exhaust deg.	45			
243	Marg. thickness Inlet standard mm	1,0			1,0 1,8 1)
244	Marg. thickness Exhaust standard mm	1,5			
245	Marg. thickness Inlet Wear limit mm	0,5			0,5 1,3 1)
246	Marg. thickness Exhaust Wear limit mm	0,7			

1) At 30° seat angel

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L913T	BF4/6L 913/C
250	Valve spring				
251	Number per valve	1			
252	Windings total	7			
253	Length unloaded standard mm	59 ± 1,9			
254	Length unloaded Fatigue limit mm	56			
260	Valve clearance				
261	Inlet (engine cold) mm	0,15			
262	Exhaust (engine cold) mm	0,15			

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
270	Distances to be checked				
271	Valve recess standard mm	5,08			
272	Wear limit mm		5,6 1)	6,6 2)	
273	Max. distance betw. cyl. head bottom + cyl. head sealing surface standard mm	6,4 1)	6,3 2)	8,3 3)	
274	Wear limit mm	5,9 1)	5,8 2)	7,8 3)	

1) With shim

2) W/o shim

3) With sealing ring (Schmitz cylinder head)

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
280	Cylinder head studs				
281	Length standard mm		211 ±0,5	217 ±0,5 1) 198 ±0,5 2)	
282	Length Limit mm		212,5	218,5 1) 200 2)	

1) Schmitz cylinder head

2) F3L 913 G up to engine ser. No.

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
300	Cylinder				
301	Bore standard mm	100 $^{+0,022}$		102 $^{+0.040}_{+0,005}$	102 $^{+0.050}_{+0,005}$
302	Bore Wear limit mm	0,1			
303	Number of oversizes	2		1	
304	Each oversize mm	0,5			
305	Height of cylinder mm	137,3		135,7 1) 124,8 2)	

1) BF6L 913/C with Schmitz cylinder head

2) F3L 913 G short cylinder liner

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
400	Piston				
401	Diameter standard mm	99,91 $\pm 0{,}009$		101,91 $^{+0{,}007}_{-0{,}008}$ 1) 101,89 $\pm 0{,}007$ 2) 101,9 $\pm 0{,}009$ 3) 101,91 $\pm 0{,}009$ 4)	101,89 $^{+0{,}017}_{-0{,}018}$
402	Number of oversizes	2		1	
403	Each oversize mm	0,5			
404	Distance between piston and cylinder head mm	1,0 - 1,2 1,0 - 1,1 5)			
405	Bore for piston pin mm	35 $^{+0{,}006}$		35 $^{+0{,}009}_{+0{,}003}$	40 $^{+0{,}006}$
406	Piston pin diameter mm	35 $_{-0{,}006}$			40 $_{-0{,}006}$

1) BFL 913
2) With cooling chanel
3) Without cooling chanel
4) F3L 913G
5) Engine with optimized exhaust emission levels

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
410	Piston ring groove height				
411	1st ring Keystone groove mm	1)			
412	2nd ring Keystone groove Rectang. groove mm	$2{,}5\ ^{+0{,}110}_{+0{,}090}$ 2)		BFL 913/C 1) $2{,}5\ ^{+0{,}10}_{+0{,}08}$ 2)	
413	3rd ring Rectang. groove mm	$5\ ^{+0{,}050}_{+0{,}030}$ 3)	$2{,}5\ ^{+0{,}11}_{+0{,}09}$ 4)	$5\ ^{+0{,}050}_{+0{,}030}$ 3)	$2{,}5\ ^{+0{,}10}_{+0{,}08}$ 4)
414	4rd ring Rectang. groove mm	$5\ ^{+0{,}05}_{+0{,}03}$ 4)			

1) Keystone groove: gauging with ring groove wear gauge

2) Rectangular groove

3) 3-ring piston

4) 4-ring piston

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
420	Piston rings				
421	Axial clearance 1st ring standard mm	——			
422	Wear limit mm	——			
423	Axial clearance 2nd ring standard mm	0,1 - 0,132 1)		0,09 - 0,122 1)	
424	Wear limit mm	0,3			
425	Axial clearance 3rd ring standard mm	0,04 - 0,072 2) 0,1 - 0,132 3)		0,04 - 0,072 2) 0,09 - 0,122 3)	
426	Wear limit mm	0,15 2) 0,3 3)			

1) At rectangular groove

2) 3-ring piston

3) 4-ring piston

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
427	Axial clearance 4rd ring standard mm	0,004 - 0,072 2)			
428	Wear limit mm	0,15			
429	Gap 1st ring standard mm	FL 912W = 0,35 $^{+0,2}$	0,3 $^{+0,15}$		
430	Wear limit mm	0,8			
431	Gap 2nd ring standard mm	0,20 $^{+0,25}$			
432	Wear limit mm	0,8			
433	Gap 3rd ring standard mm	0,25 $^{+0,15}$ 1)		0,25 $^{+0,25}$ 2)	
434	Wear limit mm	0,8			

1) 3-ring piston

2) 4-ring piston

200-400 Cylinder unit

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
435	Gap 4rd ring standard mm	0,25 $^{+0,15}$ 1)			
436	Wear limit mm	0,8			

1) 4-ring piston

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
500	Crankshaft				
510	Crankpin				
511	Pin width standard mm	$34^{+0,039}$	$36^{+0,039}$	$34^{+0,039}$	
512	Pin diameter standard I mm	F2L = $59,96_{-0,019}$ F3-6L = $59,97^{-0,010}_{-0,029}$	$64^{-0,010}_{-0,029}$	$59,97^{-0,010}_{-0,029}$	$66^{-0,010}_{-0,029}$
513	Pin diameter standard II mm	F2L = $59,71_{-0,019}$ F3-6L = $59,72^{-0,010}_{-0,029}$	$63,75^{-0,010}_{-0,029}$	$59,72^{-0,010}_{-0,029}$	$65,75^{-0,010}_{-0,029}$
514	Each undersize mm	0,25			
515	Limit for undersize mm	F2L = $58,46_{-0,019}$ F3-6L = $58,47^{-0,010}_{-0,029}$	$62,5^{-0,010}_{-0,029}$	$58,47^{-0,010}_{-0,029}$	$64,5^{-0,010}_{-0,029}$
516	Pin ovality Waer limit mm	0,01			

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
517	Radius of fillet mm	$4{,}5_{-0{,}2}$			
518	Pin hardness standard HRc	55^{+6}			
519	Limit value HV 1	500			
520	Main journal				
521	Journal width standard mm	F2L = $37_{-0{,}2}$ 1) $35{,}5_{-0{,}2}$ 2)	F3-6L = $37^{+0{,}1}$	$37^{+0{,}1}$	$36^{+0{,}1}$
522	Journal dia. standard I mm	F2L = $62^{-0{,}010}_{-0{,}029}$ F3-6L = $70^{-0{,}010}_{-0{,}029}$	$73^{-0{,}010}_{-0{,}029}$	$70^{-0{,}010}_{-0{,}029}$	$75^{-0{,}010}_{-0{,}029}$
523	Journal dia. standard II mm	F2L = $61{,}75^{-0{,}010}_{-0{,}029}$ F3-6L = $69{,}75^{-0{,}010}_{-0{,}029}$	$72{,}75^{-0{,}010}_{-0{,}029}$	$69{,}75^{-0{,}010}_{-0{,}029}$	$74{,}75^{-0{,}010}_{-0{,}029}$
524	Each undersize mm	0,25			

1) Opposite flywheel end

2) Flywheel end

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
525	Limit for undersize mm	F2L = 60,5 $^{-0,010}_{-0,029}$ F3-6L = 68,5 $^{-0,010}_{-0,029}$	71,5 $^{-0,010}_{-0,029}$	68,5 $^{-0,010}_{-0,029}$	73,5 $^{-0,010}_{-0,029}$
526	Journal ovality Wear limit mm	0,01			
527	Eccentricity max. perm. mm	F2L = 0,02 F3L = 0,06 B/F4L = 0,08		F5L = 0,08 B/F6L = 0,10	
528	Radius of fillet mm	4,5 $_{-0,2}$			
529	Journal hardness, standard HRc	55 $^{+6}$			
530	Limit value HV 1	500			
540	Thrust bearing journal	Ø as on main jornal			
541	Journal width standard I mm	F2L = 37 $^{+0,039}$	F3-6L = 37 $^{+0,025}$		36 $^{+0,025}$

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
542	Journal width standard II mm	F2L = $37{,}25^{+0{,}039}$	F3-6L = $37{,}25^{+0{,}025}$		$36{,}25^{+0{,}025}$
543	Each oversize mm	0,25			
544	Limit for oversize mm	F2L = $39^{+0{,}039}$	F3-6L = $39^{+0{,}025}$		$38^{+0{,}025}$
550	Main bearing				
551	Bearing shells inner dia. standard I mm	F2L = $62{,}05^{+0{,}043}$ F3-6L = $70{,}04^{+0{,}043}$	$73{,}042^{+0{,}039}$	$70{,}04^{+0{,}043}$	$75{,}04^{+0{,}039}$
552	Bearing shells inner dia. standard II mm	F2L = $61{,}80^{+0{,}043}$ F3-6L = $69{,}79^{+0{,}043}$	$72{,}792^{+0{,}039}$	$69{,}79^{+0{,}043}$	$74{,}79^{+0{,}039}$
553	Each undersize mm	0,25			
554	Limit for undersize mm	F2L = $60{,}55^{+0{,}043}$ F3-6L = $68{,}54^{+0{,}043}$	$71{,}542^{+0{,}039}$	$68{,}54^{+0{,}043}$	$73{,}54^{+0{,}039}$

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
555	Radial clearance standard mm	F2L = 0,06 - 0,122 F3-6L = 0,05 - 0,11	0,052 - 0,110	0,05 - 0,11	0,05 - 0,108
556	Radial clearance Wear limit mm	0,15			
560	Main bearing bore				
561	Bearing bore in crankcase standard mm	F2L = 67,0 $^{+0,019}$ 1) F3-6L = 74,5 $^{+0,019}$	77,5 $^{+0,019}$	74,5 $^{+0,019}$	79,0 $^{+0,019}$
562	Bearing bore in crankcase oversize mm	F3-6L = 75,0 $^{+0,019}$	78,0 $^{+0,019}$	75,0 $^{+0,019}$	79,5 $^{+0,019}$
570	Thrust bearing (with stop rings)				
571	Outside distance of stop rings standard I mm	36,85 $_{-0,139}$			35,86 $_{-0,133}$
572	Outside distance of stop rings standard II mm	37,10 $_{-0,139}$			36,11 $_{-0,133}$

1) End shield

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
573	Each oversize mm	0,25			
574	Limit for oversize mm	$38{,}85_{-0{,}139}$			$37{,}86_{-0{,}133}$
575	Crankshaft axial clearance standard mm	F2L = 0,11 - 0,288 F3-6L = 0,15 - 0,314			0,14 - 0,298
576	Wear limit mm	0,4			
600	Connecting rod				
601	Centre distance from small eye bush to big eye bore mm	$216_{-0{,}1}$			
602	Bore for piston pin bush mm	$38{,}0^{+0{,}016}$	$43{,}0^{+0{,}016}$	$38{,}0^{+0{,}016}$	$43{,}0^{+0{,}016}$
603	Piston pin bush Outer dia. mm	$38{,}05^{+0{,}030}$	$43{,}05^{+0{,}030}$	$38{,}05^{+0{,}030}$	$43{,}05^{+0{,}030}$

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
604	Piston pin bush (pressed in) Inner dia. mm	35,04 $^{+0,046}$	40,04 $^{+0,044}$	35,04 $^{+0,046}$	40,04 $^{+0,044}$
605	Piston pin clearance mm	0,04 - 0,091	0,04 - 0,089	0,04 - 0,091	0,04 - 0,089
606	Wear limit mm	0,15			
607	Bore for big end bearing mm	64,0 $^{+0,019}$	68,0 $^{+0,019}$	64,0 $^{+0,019}$	70,0 $^{+0,019}$
608	Big end bearing shells Inner dia. standard I mm	60,0 $^{+0,039}$	64,03 $^{+0,039}$	60,0 $^{+0,039}$	66,03 $^{+0,039}$
609	Big end bearing shells Inner dia. standard II mm	59,75 $^{+0,039}$	63,78 $^{+0,039}$	59,75 $^{+0,039}$	65,78 $^{+0,039}$
610	Each undersize mm	0,25			
611	Limit for undersize mm	58,5 $^{+0,039}$	62,53 $^{+0,039}$	58,5 $^{+0,039}$	64,53 $^{+0,039}$

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
612	Big end bearing radial clearance standard mm	0,04 - 0,098			
613	Big end bearing radial clearance Wear limit mm	0,15			
614	Big end bearing width mm	$25,0_{-0,2}$	$26,0_{-0,2}$	$25,0_{-0,2}$	
615	Connecting rod width mm	$33,6^{-0,080}_{-0,142}$ 1) $33,6^{-0,080}_{-0,180}$ 2)	$35,6^{-0,080}_{-0,180}$	$33,6^{-0,080}_{-0,142}$ 1) $33,6^{-0,080}_{-0,180}$ 2)	
616	Connecting rod axial clearance, standard mm	0,48 - 0,581 1) 0,48 - 0,619 2)			
617	Connecting rod axial clearance Wear limit mm	0,8			

1) With mass balance

2) Without mass balance

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
700	Camshaft, Intermediate gear, Bearing journal, Engine balancer				
710	Camshaft				
711	Axial clearance, standard mm	F2L = 0,2 - 0,3	0,4 - 0,7		
712	Axial clearance Wear limit mm	F2L = 0,5	1,0		
713	Camshaft bearing Inner dia. standard mm	F2L = $51{,}97^{+0{,}06}$	$47{,}98^{+0{,}054}$		
714	Radial clearance, standard mm	F2L = 0,03 - 0,109 1) 0,06 - 0,136 2) 0,05 - 0,114 3)	0,03 - 0,10 1) 0,07 - 0,12 4)		
715	Radial clearance Wear limit mm		0,2		

1) Bearing bush

2) Crankcasse centre

3) Crankcasse rear

4) Crankcasse

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
716	Cam lift Inlet mm	8			
717	Exhaust mm	8			
720	Valve timing with valve clearance adjusted mm				
721	Inlet opens before TDC degrees	F2L = 26° 1)	32° 30'		
722	Inlet closet after BDC degrees	F2L = 67° 1)	60° 30'		
723	Exhaust opens before BDC degrees	F2L = 73° 1)	70° 30'		
724	Exhaust closet after TDC degrees	F2L = 30° 1)	32° 30'		
730	Intermediate gear Bearing journal				

1) Engine with Deutz - fuel injection pump....., not boosted

500-700 Motion parts

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
731	Bearing bush internal diameter (pressed in) mm	$40^{+0,041}_{+0,025}$			
732	Journal diameter mm	$40^{-0,009}_{-0,025}$			
733	Radial clearance of bearing journal in the bush standard mm	0,034 - 0,066			
734	Wear limit mm	0,1			
735	Axial clearance, mm	0,15 - 0,30			
740	Engine balancer				
741	Backlash mm	0,22 - 0,27 *) 1) 0,20 - 0,30 **) 1) 0,1 - 0,15 2)			

*) up to engine ser. no. 4 558 111

**) as from engine ser. no. 4 558 112

1) Central drive

2) Front-end drive

800 Lubrication system

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
800	Lube oil pump				
801	Axial clearance of delivery gears standard mm	F2L = 0,038 - 0,083			
802	Axial clearance Wear limit mm	F2L = 0,1			
803	Crankshaft gear backlash mm	F2L = 0,015 - 0,164	B/F3 - 6L = 0,1 - 0,2		
810	Lube oil pressure				
811	Pressurestat bar	F2L = 5			
812	Lube oil pressure at low idling Min. bar	0,5 (650 - 700/min.)			
813	Safety valve on lube oil pump bar	F2L = 5 - 7	B/F3 - 6L = 5 - 6		

800 Lubrication system

	English	F2/3/4/5/6L 912/W	BF6L 912	F3/4/6L 913/G BF4/6L 913T	BF4/6L 913/C
814	By-pass valve on lube oil cooler bar	1,5			
815	By-pass valve on filter housing bar	2,3 - 3,2			

900 Tightening Specifications

	English	Initial tightening Nm	Tightening angles 1.	2.	3.	4.	Total	Remarks
901	Bolts for fastening filter bracket and transfer case	25					50 Nm	
902	Cylinder head studs	40	45	45	45	30	165°	
903	Big end bolt	30	60	30	-	-	90°	
904	Main bearing bolts	30	60	45	-	-	105°	
905	Flywheel bolts	30	30	30	-	-	60°	
906	Crankshaft counterwt. bolt	30	30	30	-	-	60°	
907	Flywheel nuts	50	90	90	-	-	180°	
908	Bolt for securing vee-belt pulley	50	210 120 1)	-	-	-	210° 120° 1)	

1) Tractor

900 Tightening Specifications

	English	Initial tightening Nm	Tightening angles 1.	2.	3.	4.	Total	Remarks
909	Nut for veebelt pulley	50	60				60°	
910	Injector fastening						25 - 30 Nm 100 ± 10Nm 1)	
911	Bolt for idler gear bearing	30					60°	
912	Nut on fuel-injection pump drive						60 - 70 Nm 80 - 90 Nm 2)	
913	Bolts for fastening camshaft gear						30 Nm	F2L912
914	Injector/ cap nut						60 - 80 Nm	
915	Nut for hydraulic pump						50 - 60 Nm	
916	Nut for rocker arm bracket						28 Nm	

1) FL 912 W

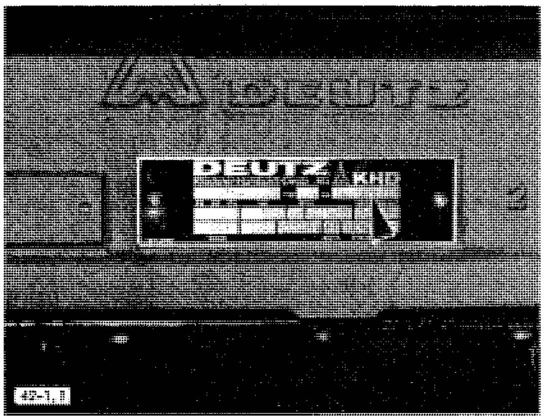
2) Clamping nut M14 x 1,5

900 Tightening Specifications

	English	Initial tightening Nm	Tightening angles 1.	2.	3.	4.	Total	Remarks
917	Bolt for cylinder head rocker chamber cover						10^{+5}_{-3} Nm	
918	Anti-fatigue bolt for cooling blower	30					90°	
919	Sealing nut for oilcontrolled fan	50					90°	
920	Cheese-head bolt (hydr. cooling air fan)						$8{,}5^{+3}$ Nm	
921	Screw plug in cylinder head						80 - 90 Nm	
922	Bolts for fastening support cross bearers of engine balancer						30 Nm	
923	Hex. nut (engine balancer)						100 Nm	
924	Bolt for drive gear (engine balancer)	20					60°	

900 Tightening Specifications

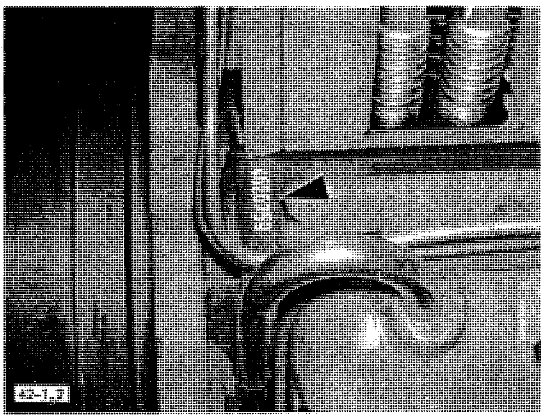
	English	Initial tightening Nm	Tightening angles 1.	2.	3.	4.	Total	Remarks
925	Union screw for oil connecting pipe						80^{+20} Nm	
926	Bolts for fastening oil pump						35 Nm	B/F 3-6 L



1-1

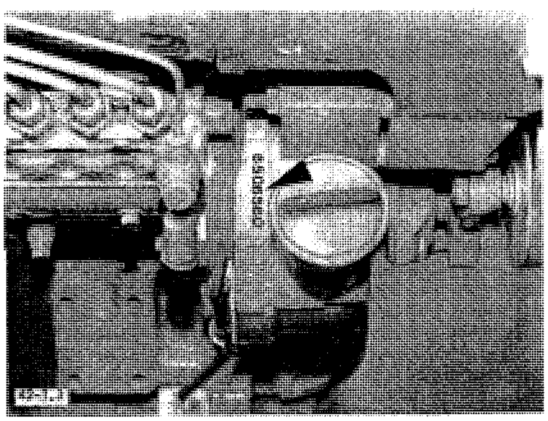
ENGINE SERIAL NUMBERS

The engine serial number is stamped on the nameplate - Fig. 1-1



1-2

- On the F2L engine it is stamped on the cylinder seating surface above the injection pump cover at flywheel end - Fig. 1-2



1-3

- For engines with 3 and more cylinders the engine serial numbers is stamped on the housing flange of the fuel injection pump behind the oil filler neck. Fig. 1-3

NAMEPLATE

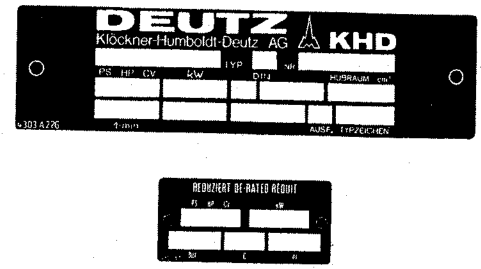
The nameplate gives details of the engine model. Typical model designation, e.g. BF6L 913 C

B = Turbocharged engine
F = High-speed, four-stroke engine
6 = Number of cylinders
L = Air-cooled
9 = Series
13 = Lenght of piston stroke in cm

Letters at the end of the model designation have the following meanings:

C = Engine with charge air cooler
G = Engine for fork lift
P = Uprated power due to substantial component modifications
T = Lightly turbocharged
W = Two-stage combustion principle (swirl-chamber engine)

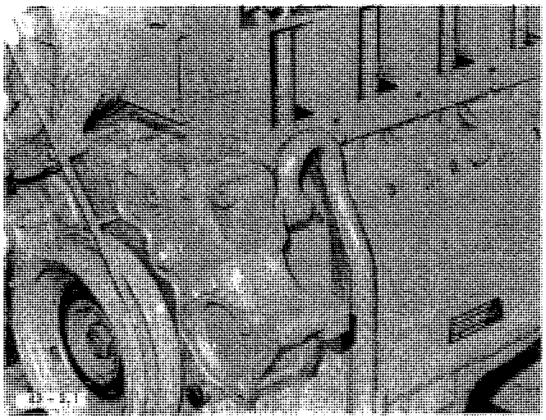
Also stated on the nameplate is the engine speed at the rated power measured in KW and HP. Besides the power rating appears the letter "A" denoting the overloadable continuous "A" rating, or the letter "B", denoting the non-overloadable "B" rating in accordance with DIN 6270. Equipment engines with derated power have an additional plate.
Fig. 1-4



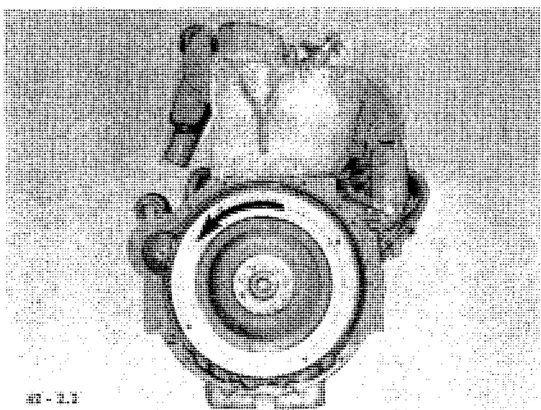
42-1,4

1-4

The rating specified for automotive engines refers to DIN 70020.



1-5



1-6

GENERAL INSTRUCTIONS FOR REPAIRS

Utmost cleanliness, accuracy and orderliness are essential prerequisites for carrying out repairs.

The engine components must be cleaned thoroughly. Cleaning of the components of the electrical system and of the fuel injection system calls for particular care. For carrying out repairs be sure to use only the special tools for your particular engine version and the necessary commercial tools.

"Front end" designates the engine end opposite the flywheel end. The cylinder numbers are stamped on the LH-side of the crankcase, starting from the flywheel end. Fig. 1-5

The crankshaft rotation is counter-clockwise as viewed from the flywheel end. Fig. 1-6

When dismantling the engine, mark the components of the motion parts, timing gears, piston and cylinder heads in consecutive order, unless already provided. Start from the flywheel end.

Put down removed components carefully to avoid damage. Gauge all wearing parts. Where the wear limits are reached or even exceeded, replace or overhaul components. Seals and sealing rings must be replaced in any case.

For spare parts nos. see parts list pertaining to the particular engine. Good running performance is ensured only when using genuine Deutz spare parts.

If bearings or pistons are defective, inspect crankshaft and connecting rod(s) for cracks, using the magnaflux method. It is absolutely necessary to trace the cause of the defects. Checks, repairs or reworking are carried out by the manufacturer or by manufacturer-owned repairshops. For work on the removed engine it is advisable to use the swivelling-type engine assembly stand no. 6067.

Index

2. Checking and Adjusting

Page

ADJUSTING VALVE CLEARANCE
(F2L 912)

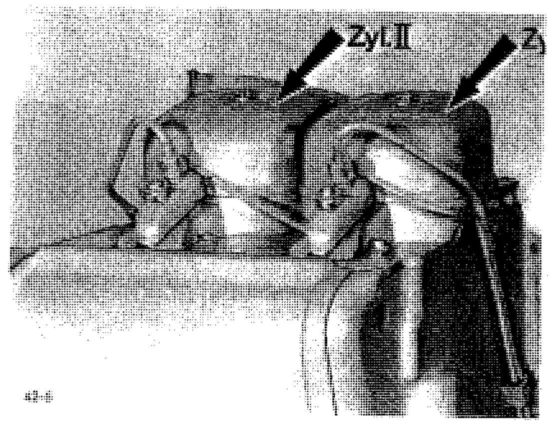
Special tool required:

Retainer .... No. 143400

Attention:

Adjust valve clearance with engine cold, i.e. the engine must have cooled down to ambient temperature.

1. Remove rocker chamber covers.
Fig. 2-1

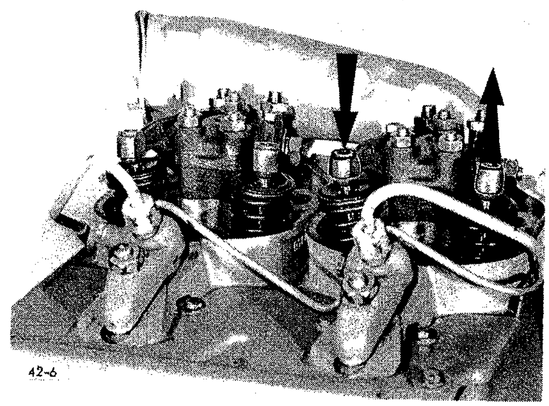


2-1

2. Turn engine until valves of cylinder No. 1 overlap.

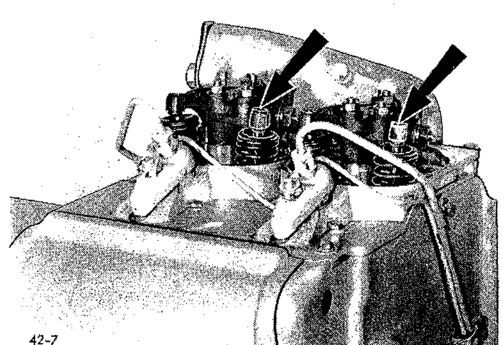
Note:

Valves overlapping means: Exhaust valve about to close, inlet valve about to open. Both pushrods are now non-rotatable.
Fig. 2-2

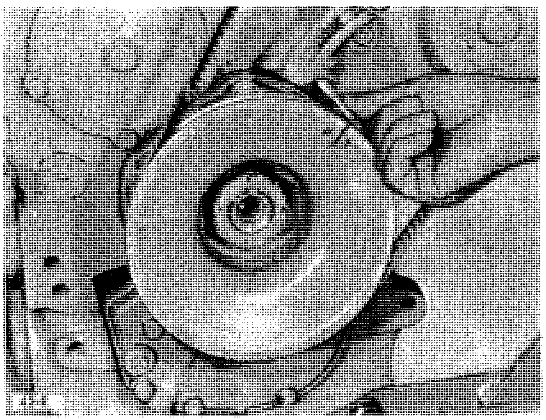


2-2

3. Viewed from the air supply side, the exhaust valve of the relevant cylinder is on the right.
Fig. 2-3

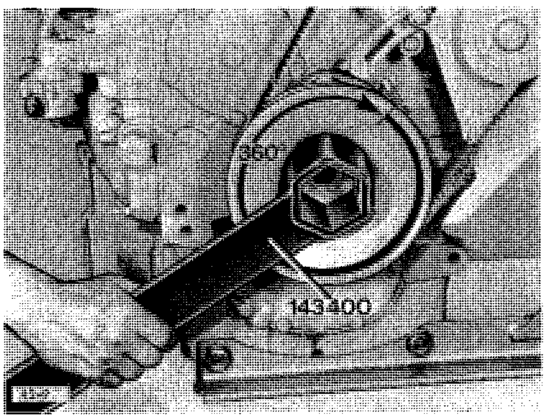


2-3



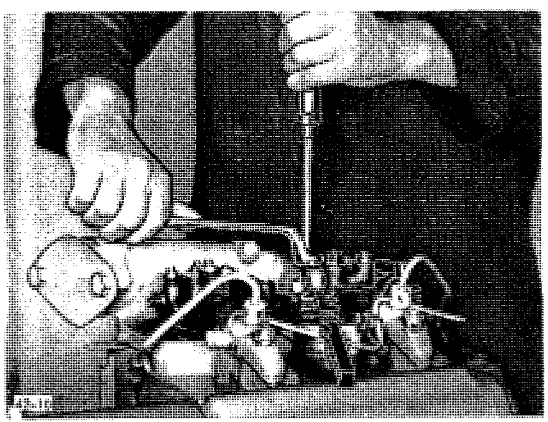
2-4

4. When the valves of cylinder No. I overlap, the TDC mark on the V-belt pulley coincides with the dowel sleeve fitted in the front cover.
Fig. 2-4



2-5

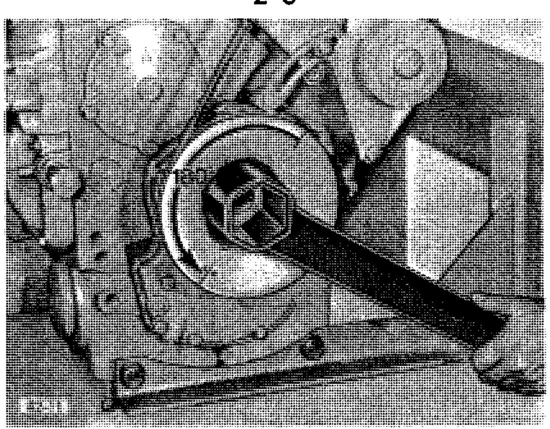
5. Turn engine further by one revolution (360°).
Fig. 2-5



2-6

261
262

6. Adjust valve clearance at cylinder No. Release locknut of adjusting screw. Insert feeler gauge between rocker arm and end of valve stem. Correct clearance by means of adjusting screw. Tighten locknut and recheck the adjustment with feeler gauge.
Fig. 2-6



2-7

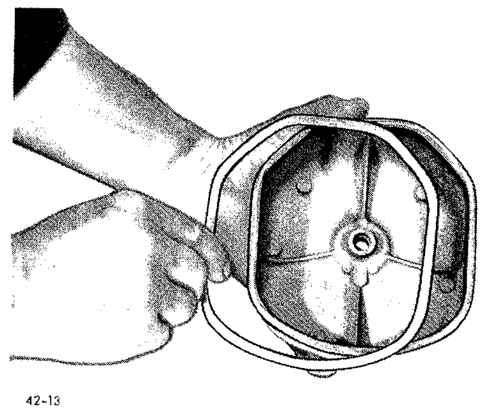
7. Turn engine backwards by half a rotation (180°).
Fig. 2-7

8. Adjust valve clearance at cylinder No. 2.
Fig. 2-8

261
262

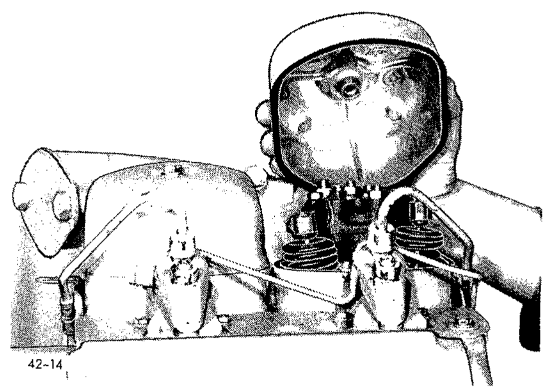
2-8

9. Apply sealing compound to gasket and affix same to rocker chamber cover with graphited surface facing towards cylinder head.
Fig. 2-9



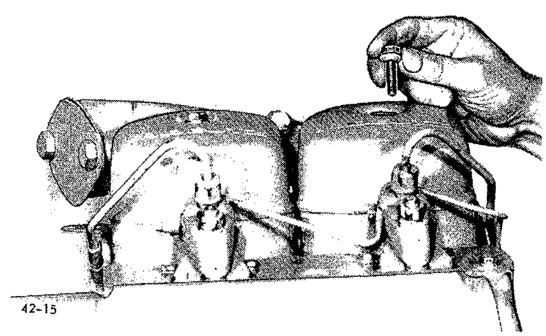
2-9

10. Fit cover in place.
Fig. 2-10

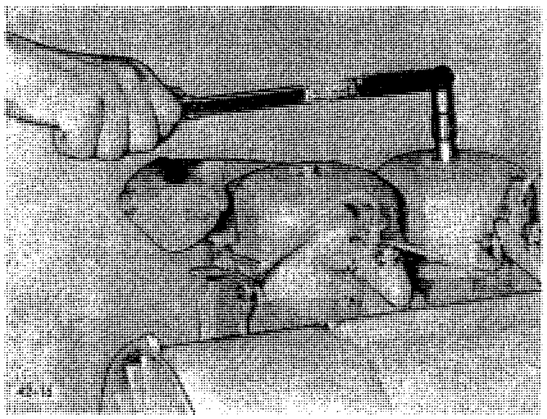


2-10

11. Insert fastening bolt complete with joint washer.
Fig. 2-11



2-11



2-12

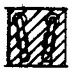
917

12. Tighten fastening bolts as per instructions.
Fig. 2-12

ADJUSTING VALVE CLEARANCE ON 3 - 6-CYL. ENGINES

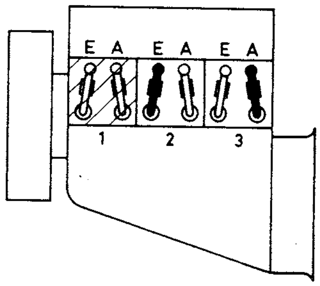
The valve clearance is adjusted in accordance with the diagram on page 2/5.

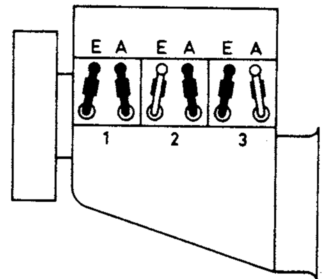
Valve Clearance Setting Diagram

Crankshaft position 1	Crankshaft position 2
 Valves overlapping with crankshaft at position 1	Crankshaft turned forward from position 1 by 360°

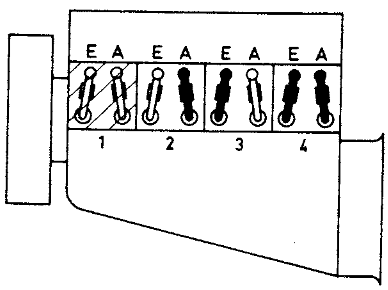
not ready for setting  ready for setting E = Inlet valve A = Exhaust valve

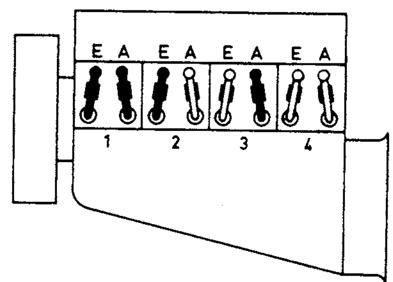
3 - Cyl. Engines



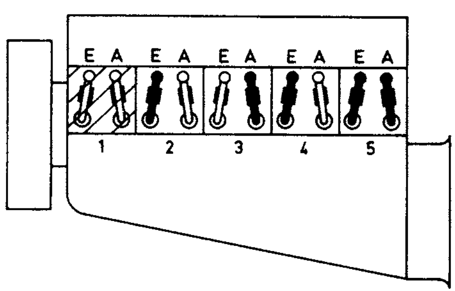


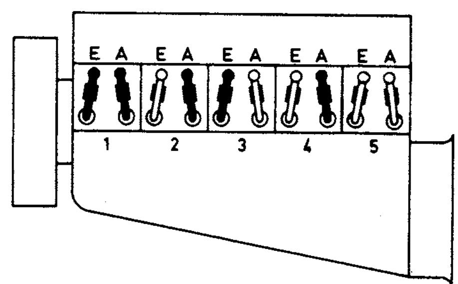
4 -



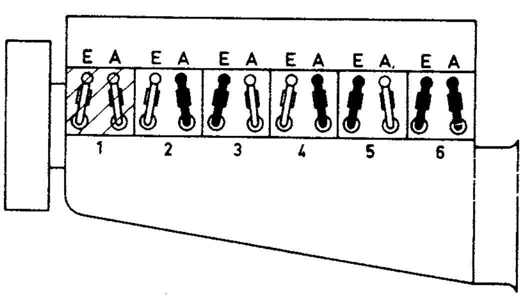


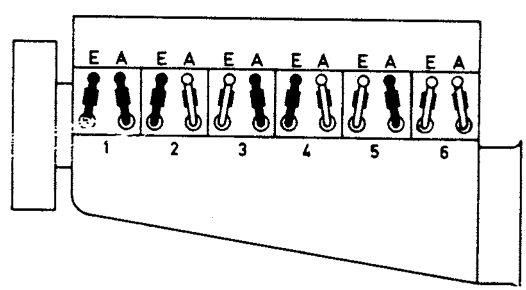
5 -





6 -



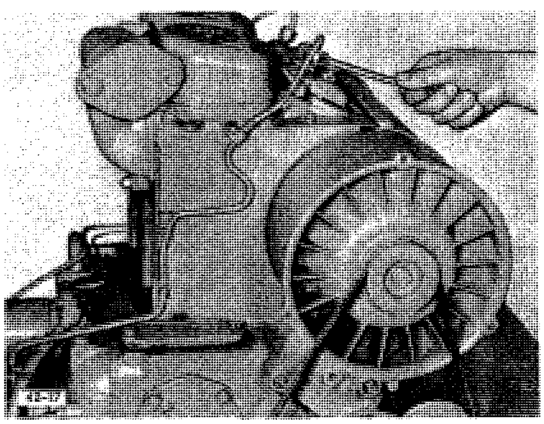


CHECKING COMPRESSION PRESSURE
(engine with direct injection)

Prior to measuring the compression pressure, check valve clearance. Then run up engine briefly to medium speed, so that combustion chamber will be sufficiently sealed by an oil film.

Special tools required:

Compression tester ...	No.	2461
Adapter	No.	100020
Adapter	No.	100040
Adapter	No.	100050
Extractor	No.	110030
Extractor	No.	120630
Extractor	No.	150800

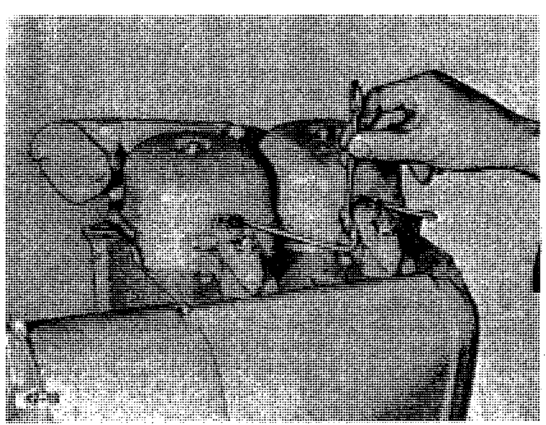


2-13

1. Detach injection lines.

Note:

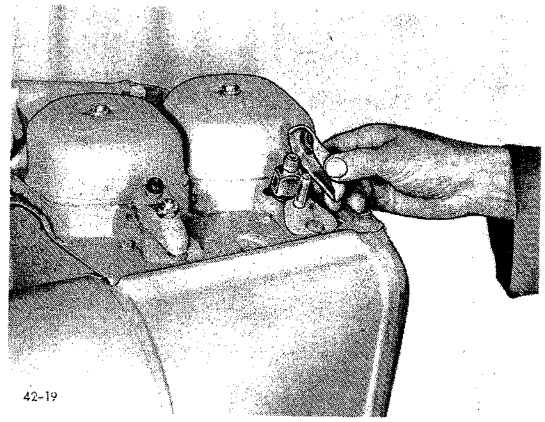
Close connection port of injection pump with protective caps.
Fig. 2-13



2-14

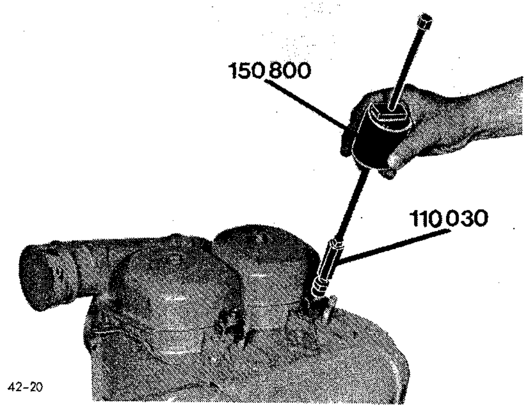
2. Detach backleakage line.
Fig. 2-14

3. Remove fastening nut and clamping bridge at both cylinder heads.
Fig. 2-15



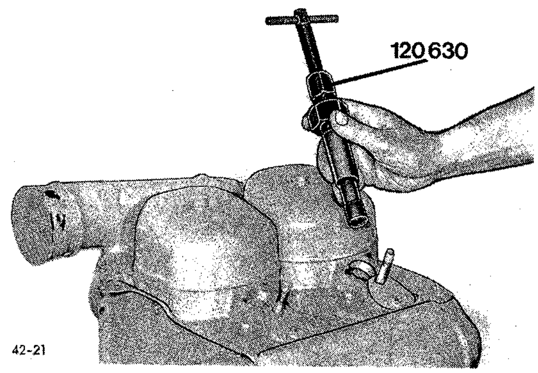
2-15

4. Remove injectors.
Fig. 2-16



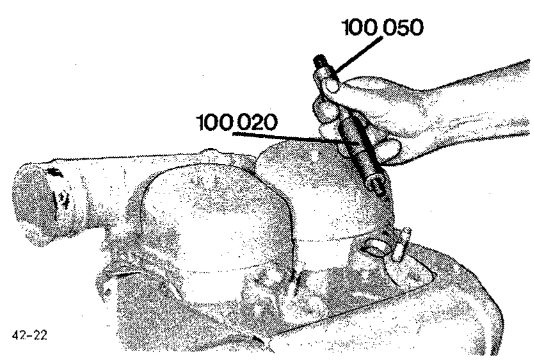
2-16

5. Remove any sealing rings left in cylinder head.
Fig. 2-17

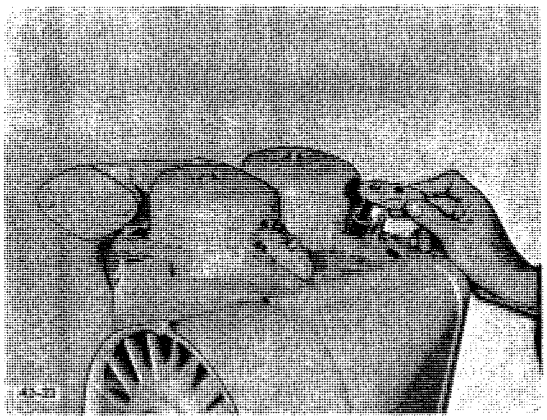


2-17

6. Insert adapter into cylinder head, fitted with a special sealing ring.
Fig. 2-18

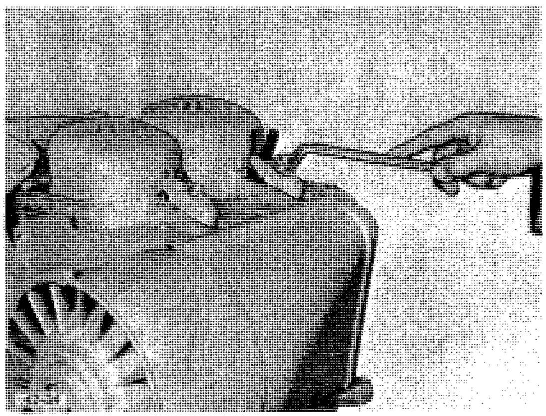


2-18



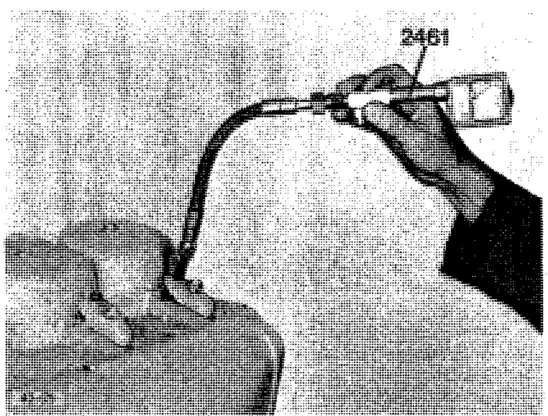
2-19

7. Place on clamping bridge.
Fig. 2-19



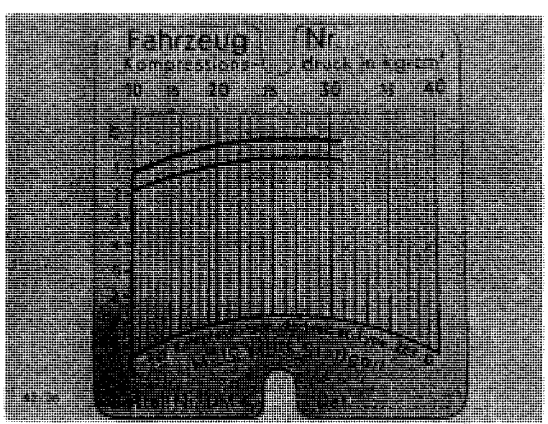
2-20

8. Screw on fastening nut.
Fig. 2-20



2-21

9. Connect compression tester. Setvinjection pump to zero delivery. Turn engine with starter.
Fig. 2-21



2-22

10. The measured compression pressure is dependent on the starter speed when measuring, and also on the altitude of place of engine application. Limiting values are therefore difficult to lay down exactly. It is recommended to regard the compression pressure measurement only as a comparison measurement of all cylinders of the engine. If a difference in pressure exceeding 15% is determined, the cylinder unit concerned should be dismantled to find out the cause.
Fig. 2-22

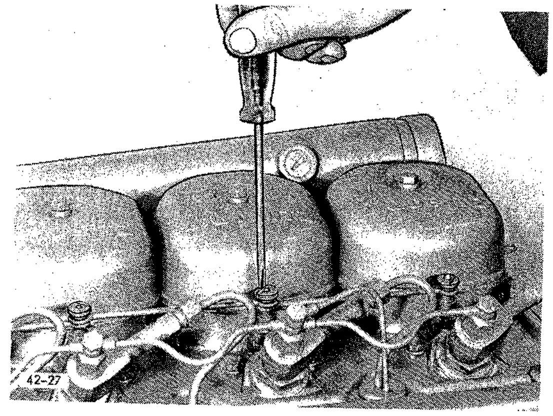
11. Remove tester and adapter. Install injector in reversed order.

CHECKING COMPRESSION PRESSURE
(engine with two-stage combustion)

Special tools required:

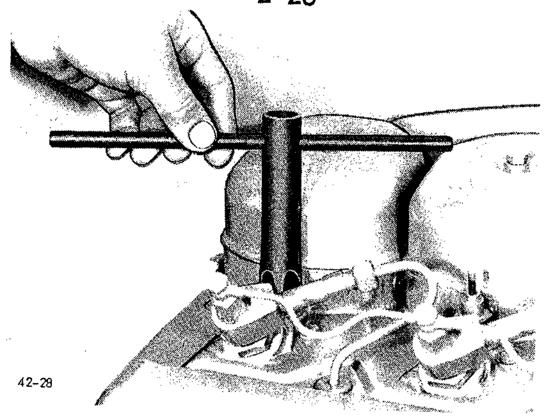
Compression tester ... No. 2461
Adapter .... No. 100040

1. Detach electrical cable and contact rails.
Fig. 2-23



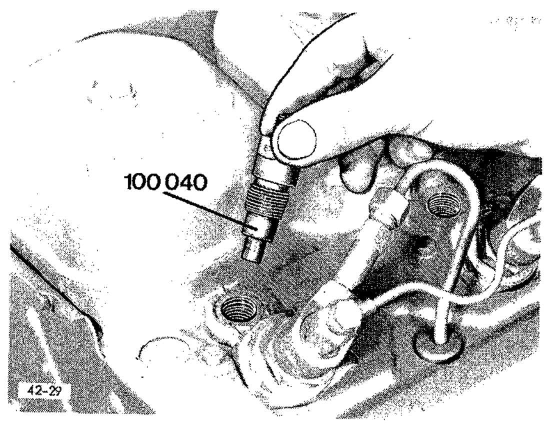
2-23

2. Remove heater plugs.
Fig. 2-24



2-24

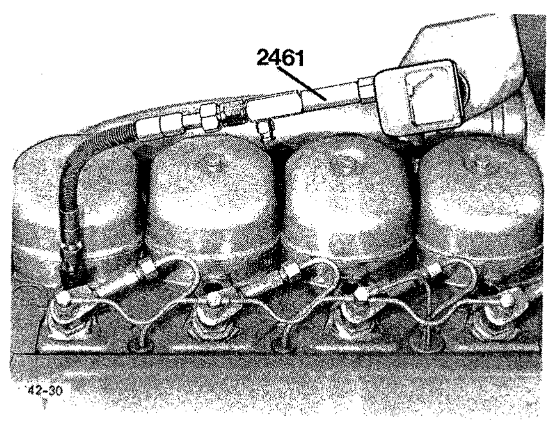
3. Install adapter.
Fig. 2-25



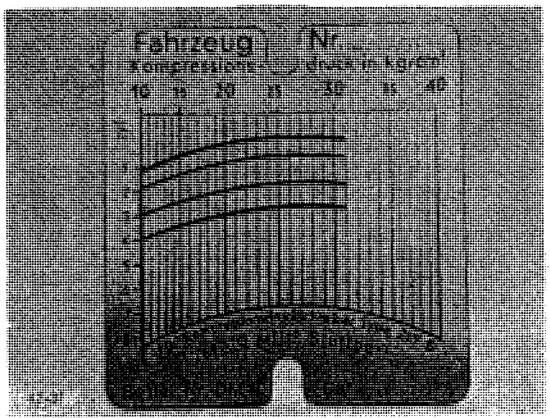
2-25

4. Connect compression tester. Set injection pump to zero delivery. Turn engine with starter.
Fig. 2-26

011



2-26



2-27

5. The measured compression pressure is dependent on the starter speed when measuring, and also on the altitude of place of engine application. Limiting values are therefore difficult to lay down exactly. It is recommended to regard the compression pressure measurement only as a comparison measurement of all cylinders of the engine. If a difference in pressure exceeding 15% is determined, the cylinder unit concerned should be dismantled to find out the cause. Fig. 2-27

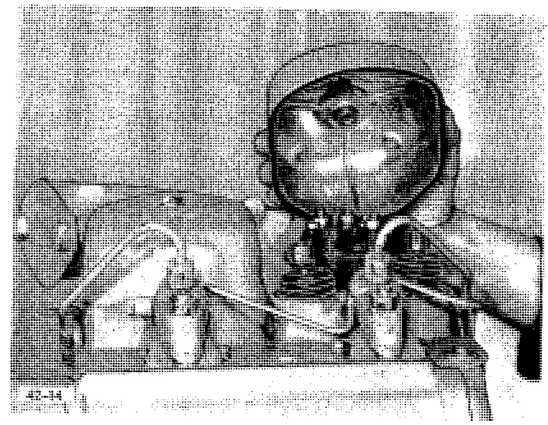
6. Remove compression tester and adapter. Re-install heater plugs.

DETERMINING TOP DEAD CENTRE (TDC)
Shown on F2L 912.

The procedure described applies also to 3 - 6-cylinder engines.

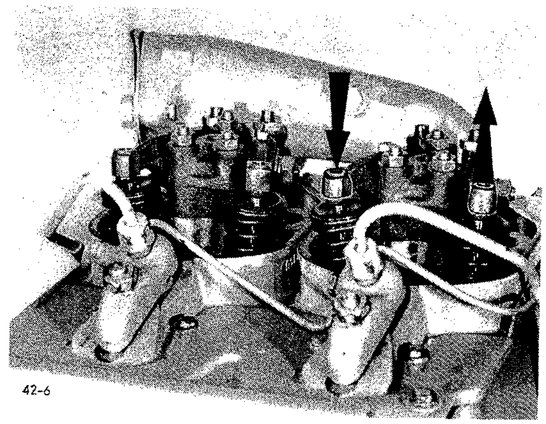
Special tools required:

Dial gauge	No. 100400
Adjusting device	No. 100640
Pointer	No. 101300
Retainer	No. 143400



2-28

1. Remove rocker chamber cover on cylinder "I".
Fig. 2-28

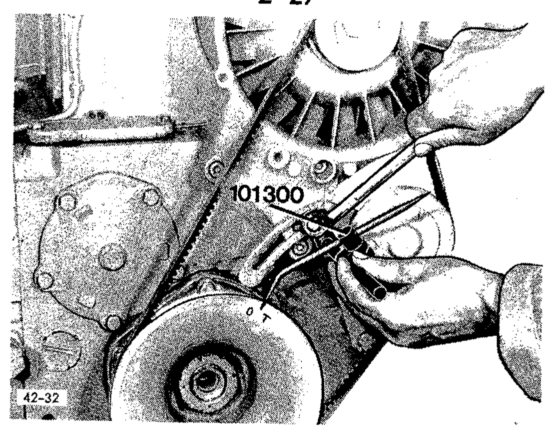


2-29

2. Turn engine until valves of cylinder "I" overlap.

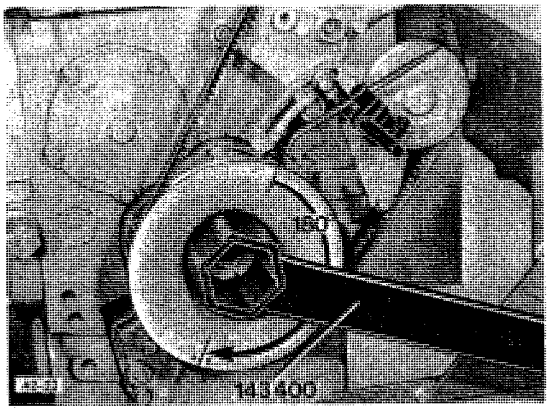
Note:

Valves overlapping means: Exhaust valve about to close, inlet valve about to open. Both pushrods are now non-rotatable.
Fig. 2-29



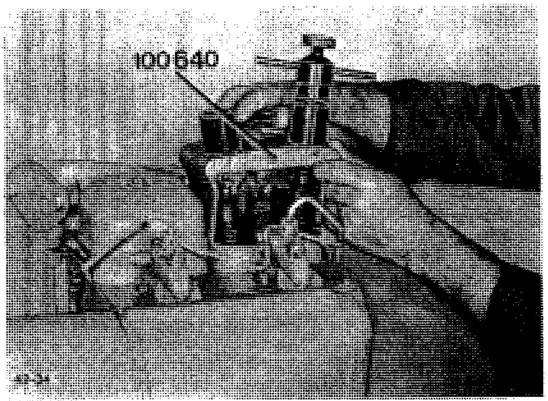
2-30

3. Mount pointer.
Fig. 2-30



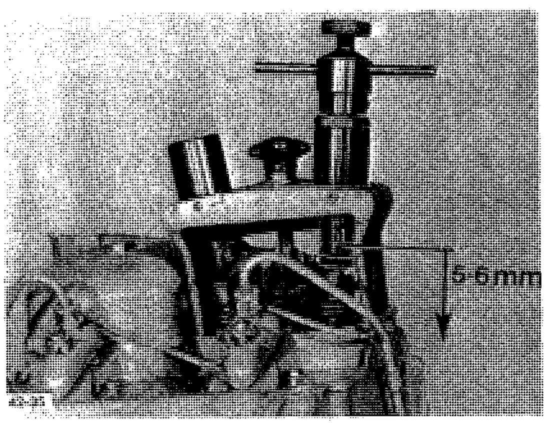
2-31

4. Turn engine further by 180°.
Fig. 2-31



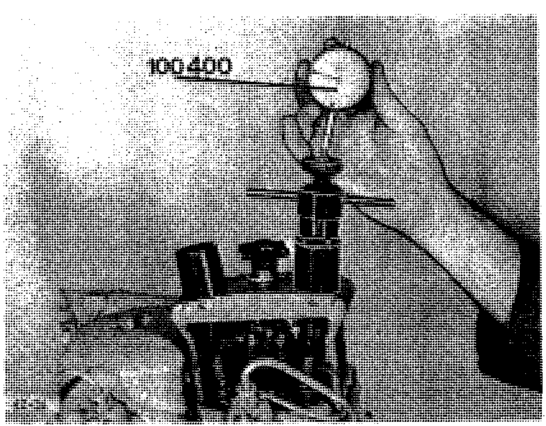
2-32

5. Mount adjusting device on cylinder I.
Fig. 2-32



2-33

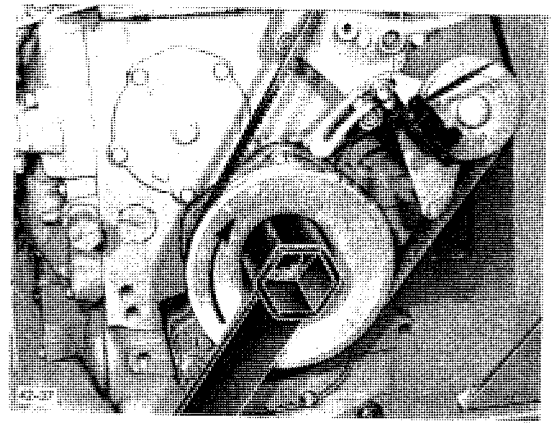
6. Using pressure screw of device, press down one rocker arm by about 5-6 mm.
Fig. 2-33



2-34

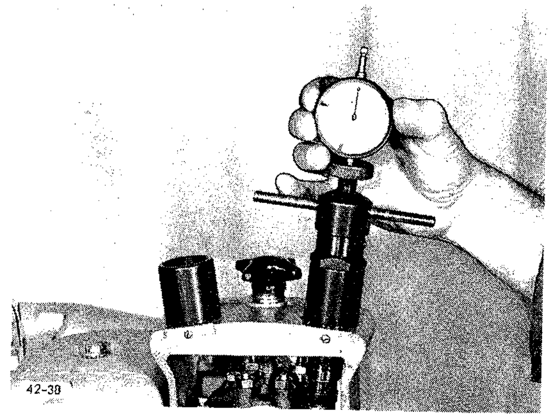
7. Fit dial gauge with preload.
Fig. 2-34

8. Turn crankshaft in normal direction of rotation until gauge pointer begins to move.
Fig. 2-35



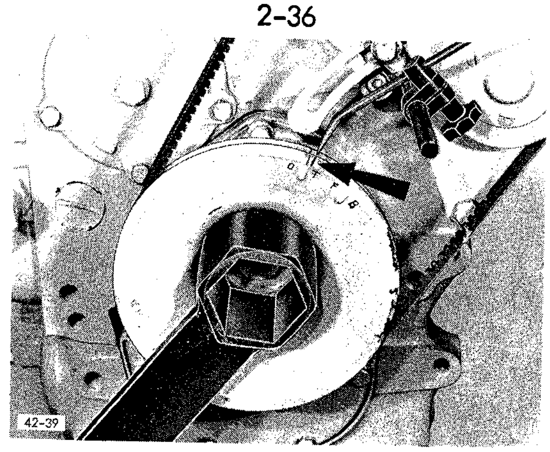
2-35

9. Turn crankshaft slowly further until the dial gauge pointer has just reached its reversal point. Set gauge to "0".
Fig. 2-36



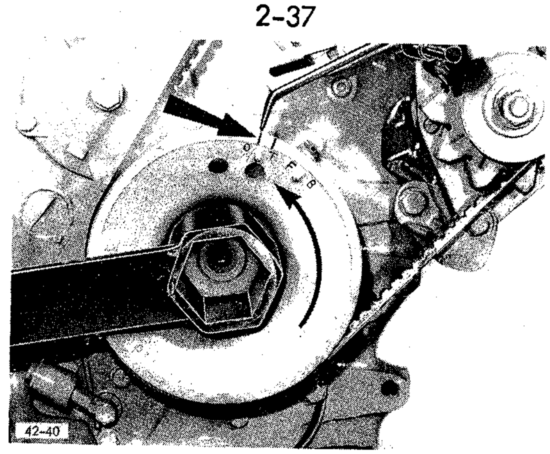
2-36

10. Apply mark.
Fig. 2-37

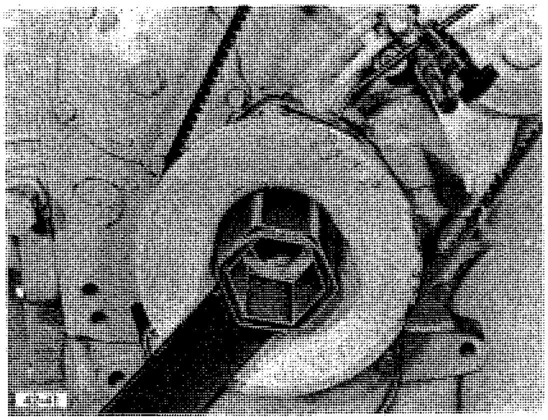


2-37

11. Turn carnkshaft further by half a rotation. Then turn crankshaft in direction opposite to normal rotation until the dial gauge pointer has again just reached its reversal point. Apply second mark.
Fig. 2-38



2-38


2-39

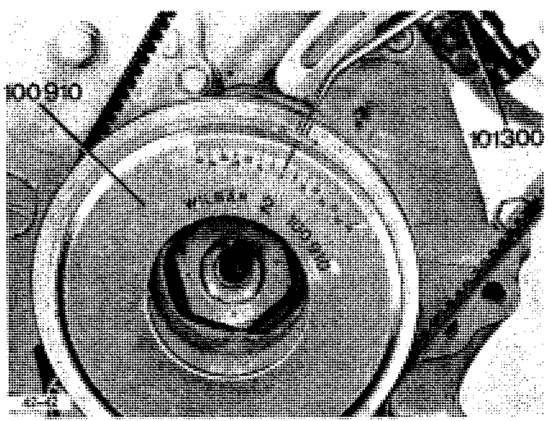
The mid-way point between the two marks is TDC (=OT). If the second mark coincides with the first mark, this is the TDC position.
Fig. 2-39

CHECKING AND ADJUSTING BEGINNING OF DELIVERY ON F2L 912 WITH DEUTZ FUEL INJECTION PUMP

Special tools required:

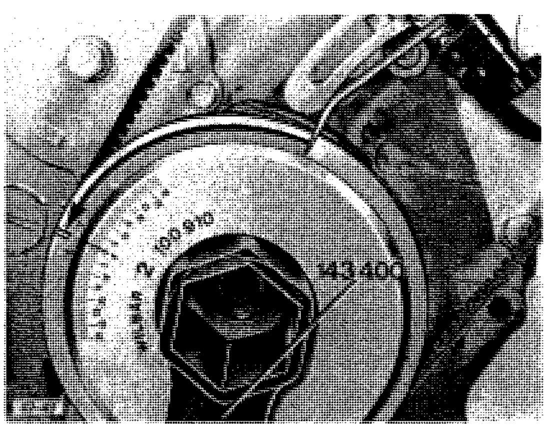
Protractor disc	No. 100910
Pointer	No. 101300
H.P. hand feed pump	
with accessories	No. 101500
Reservoir tank	No. 101510
Retainer	No. 143400

TDC-point has been determined.
Pointer has been mounted.



2-40

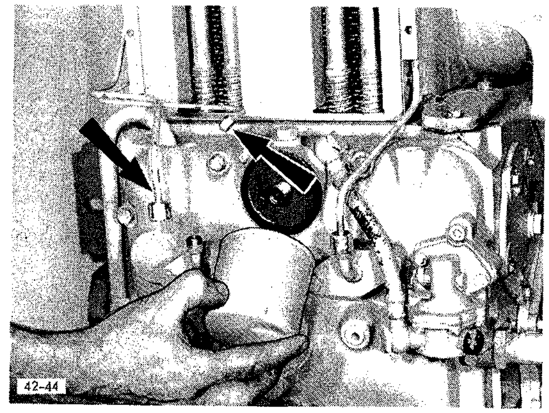
1. Mount protractor disc. Adjust so that TDC mark coincides with "0".
Fig. 2-40



2-41

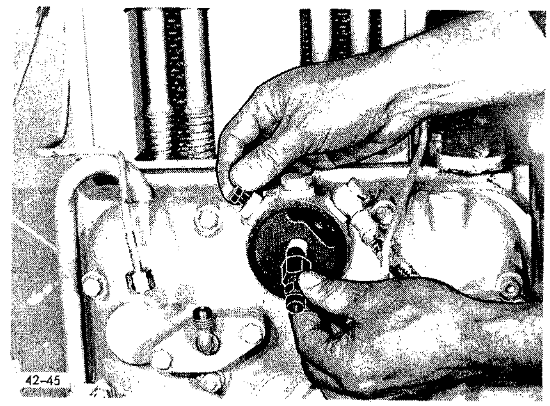
2. Turn crankshaft by about 90° in direction opposite to normal rotation.
Fig. 2-41

3. Remove fuel filter, detach injection line of cyl. I and backleakage line.
Fig. 2-42



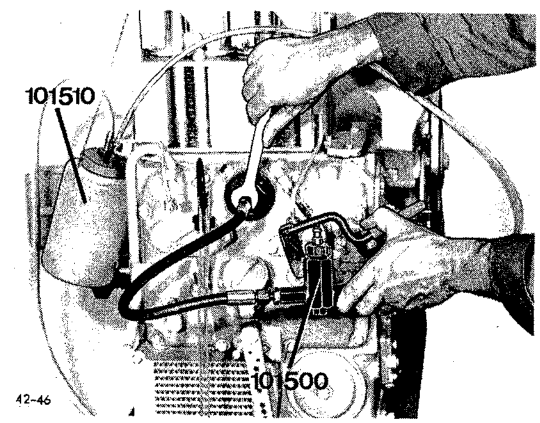
2-42

4. Close bore for backleakage line with plug. Connect adapter for H.P. hand feed pump.
Fig. 2-43



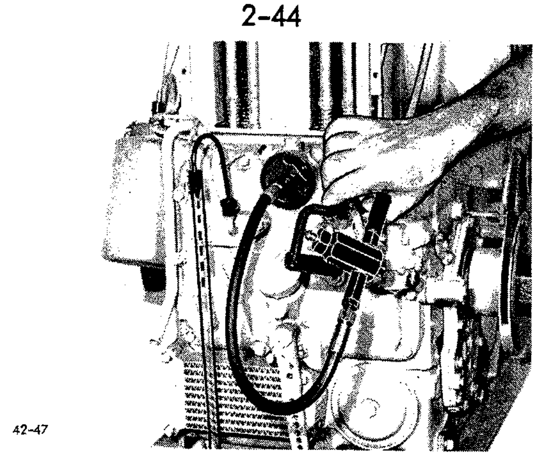
2-43

5. Mount H.P. hand feed pump and reservoir tank. Fill latter with fuel.
Fig. 2-44

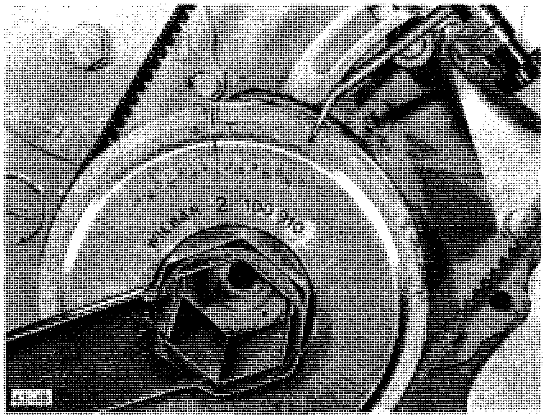


2-44

6. Actuate H.P. hand feed pump. Turn crankshaft slowly in direction of normal rotation until the flow of fuel is transformed to droplets only.
Fig. 2-45

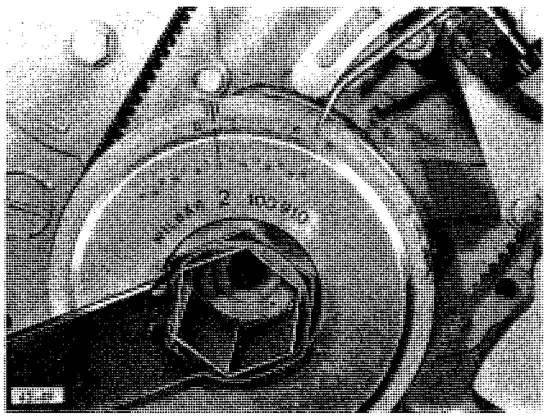


2-45



2-46

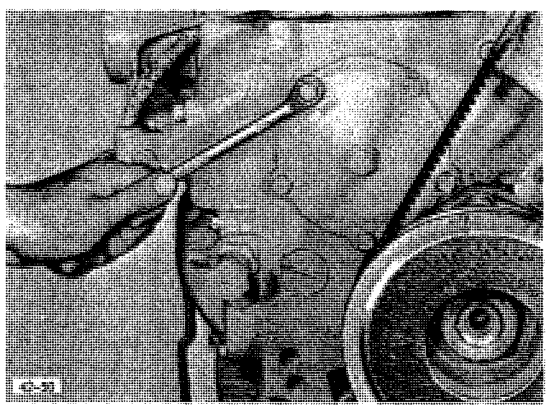
7. Read off beginning of delivery point at protractor disc.
Fig. 2-46



2-47

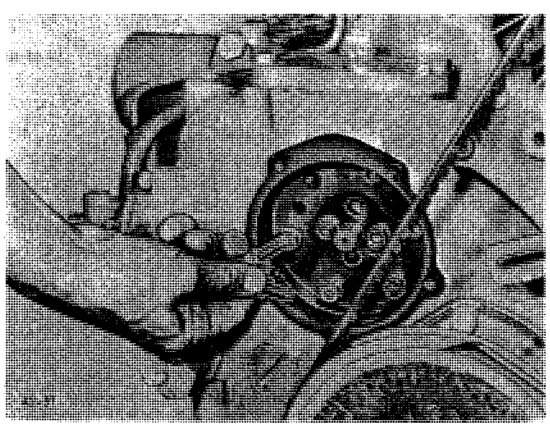
If the beginning of delivery does not agree with the specification data, correct as follows:

1. Turn crankshaft until nominal value for beginning of delivery coincides at protractor disc and pointer.



2-48

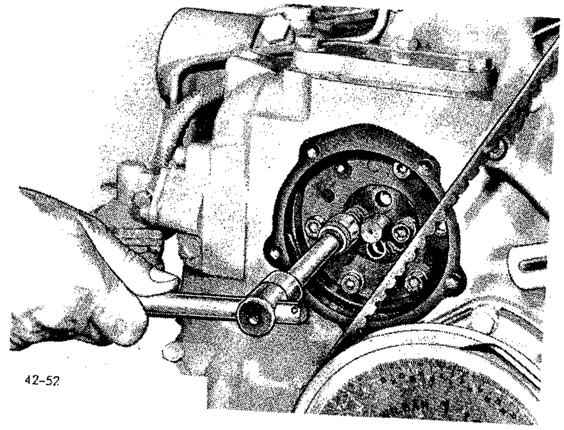
2. Remove camshaft cover.
Fig. 2-48



2-49

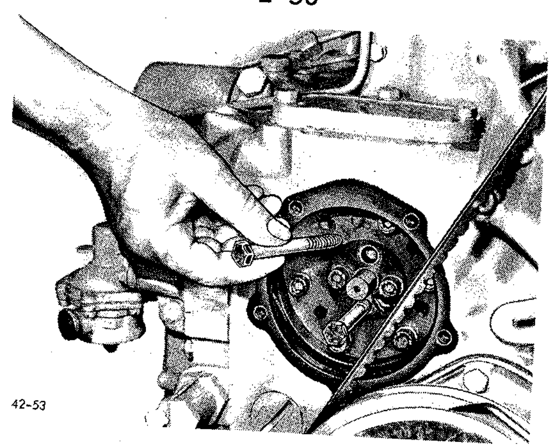
3. Screw out two opposing fastening bolts of the camshaft gear.
Fig. 2-49

4. Loosen remaining fastening bolts.
Fig. 2-50



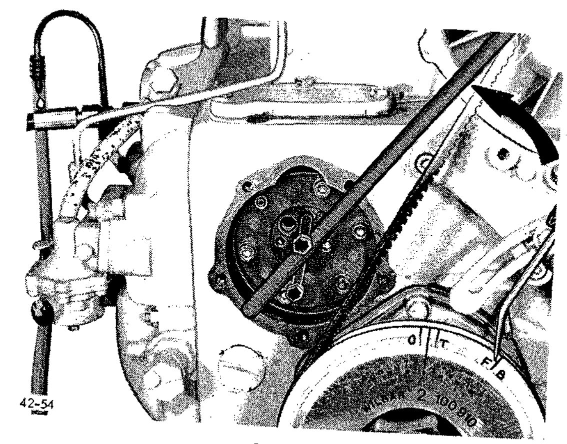
2-50

5. Screw two M8x80 auxiliary bolts into the empty threaded holes.
Fig. 2-51



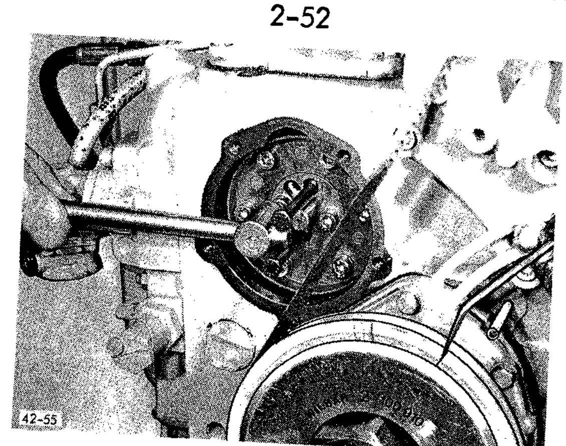
2-51

6. Actuate H.P. hand feed pump and turn camshaft until the flow of fuel is transformed to droplets only.
Fig. 2-52

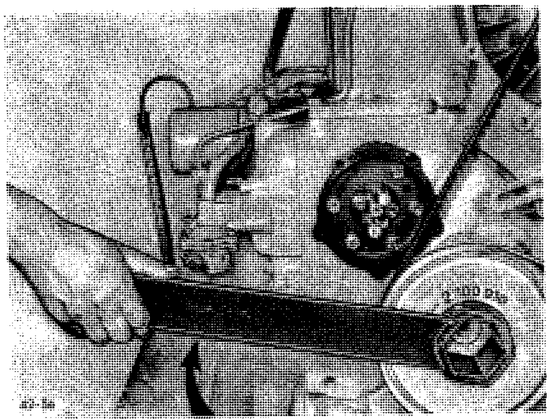


2-52

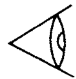
7. Tighten the loosened fastening bolts.
Fig. 2-53

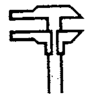


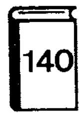
2-53



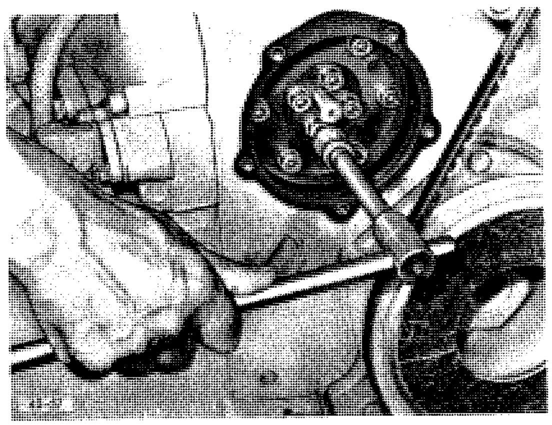
2-54



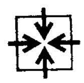




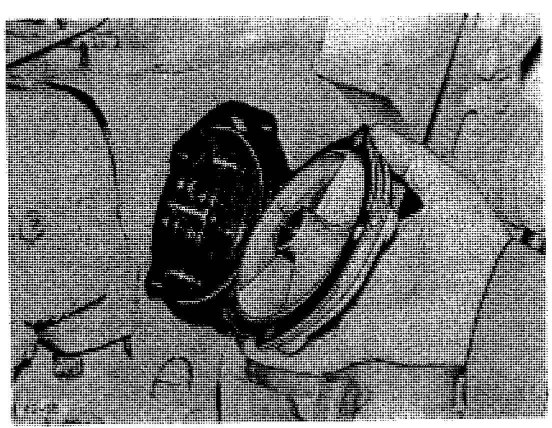
8. Recheck beginning of delivery.
Fig. 2-54



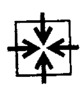
2-55



9. Remove auxiliary bolts, refit the normal fastening bolts, and tighten up.
Fig. 2-55



2-56



10. Refit camshaft cover.
Fig. 2-56

Remove test equipment. Refit removed parts of engine.

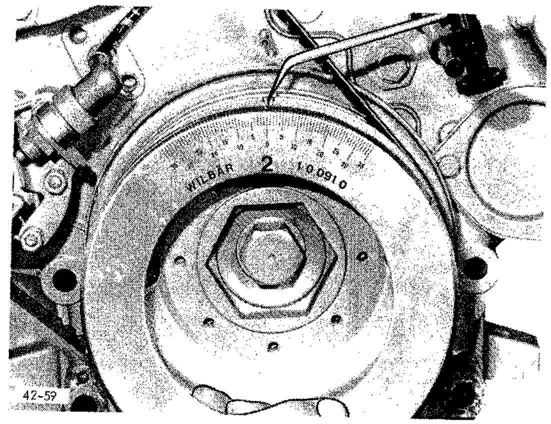
CHECKING AND ADJUSTING BEGINNING OF DELIVERY ON F2L 912 AND 3 - 6-CYL. ENGINES WITH BOSCH FUEL INJECTION PUMP

Special tools required:

Protractor disc ...... No. 100910
H.P. hand feed pump .. No. 101500
Reservoir tank .... No. 101510
Special wrench A-pump. No. 110310
Special wrench MW-pump No. 110390

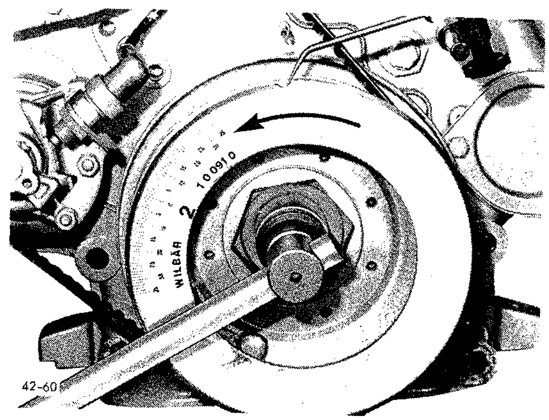
TDC-point has been determined.

1. Mount protractor disc. Adjust so that TDC mark coincides with "0".
Fig. 2-57



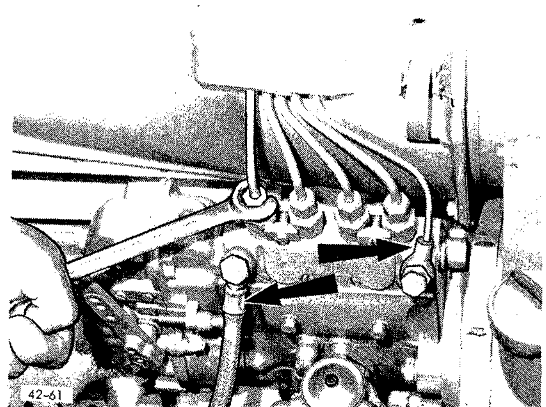
2-57

2. Turn crankshaft by about 90° in direction opposite to normal rotation.
Fig. 2-58

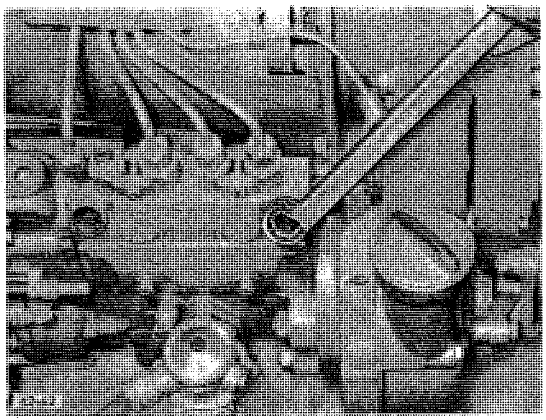


2-58

3. Detach injection line of cyl. 1, fuel line and overflow line.
Fig. 2-59

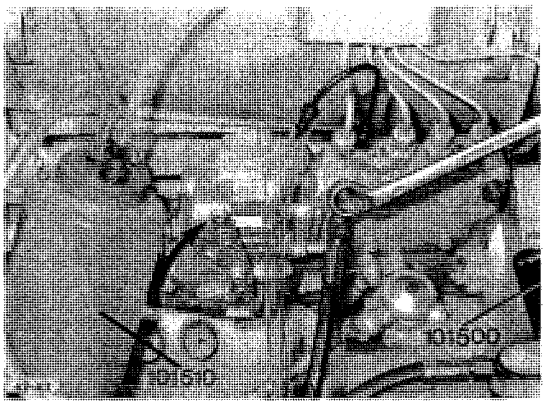


2-59



2-60

4. Close suction chamber of injection pump with plugs.
Fig. 2-60

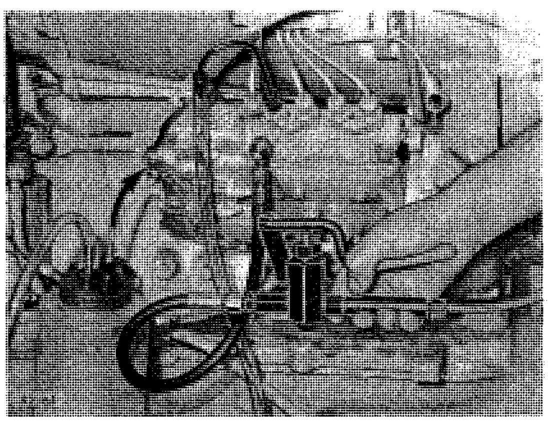


2-61

5. Mount H.P. hand feed pump c/w accessories. Fill reservoir tank with fuel.

Note:

Fix control lever at max. position.
Fig. 2-61

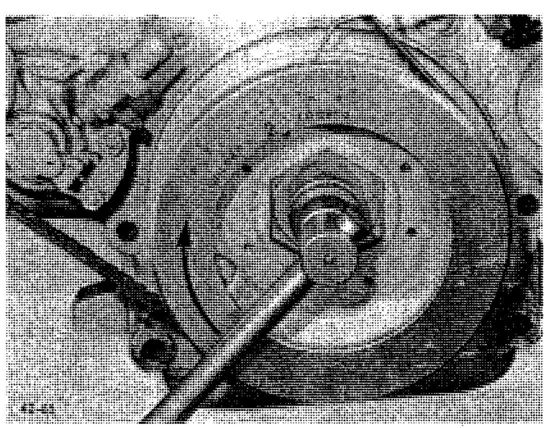


2-62

6. Actuate H.P. hand feed pump. Turn crankshaft slowly in direction of normal rotation until the flow of fuel is transformed to droplets only.

Note:

Before actuating H.P. hand feed pump, air-bleed suction chamber of injection pump at screw plug.



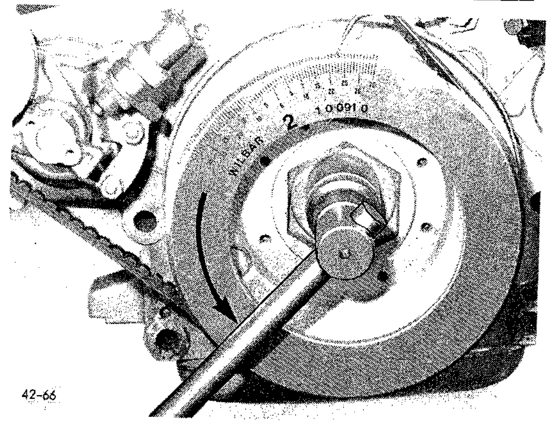
2-63

7. Read off beginning of delivery point at protractor disc.
Fig. 2-63

140

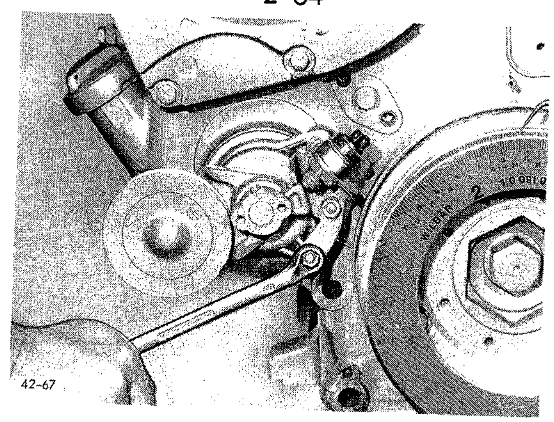
If the beginning of delivery does not agree with the specification data, correct as follows:

8. Turn crankshaft until nominal value for beginning of delivery coincides at protractor disc and pointer.
Fig. 2-64



2-64

9. Remove V-belt tensioner or cover.
Fig. 2-65

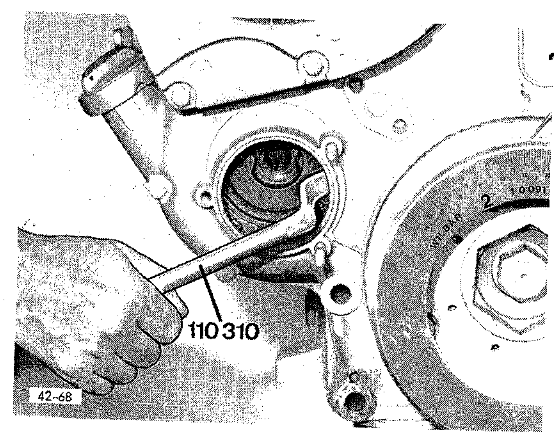


2-65

10. Loosen fastening bolts of advance/retard unit.
Fig. 2-66

Nota:

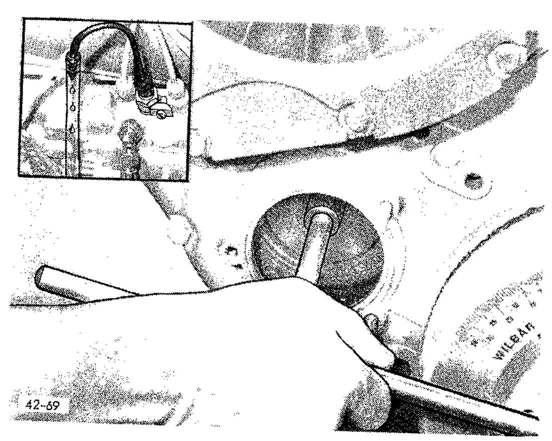
For advance/retard unit with 25 mm cone and for MW-injection pumps a new special tool is available. See Special Tools List given in the appendix.



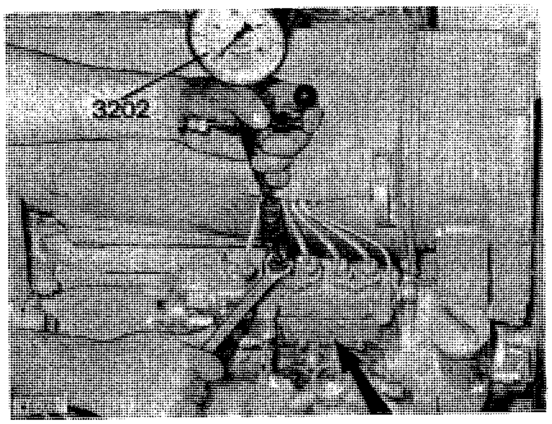
2-66

11. Actuate H.P. hand feed pump and turn injection pump camshaft until the flow of fuel is transformed to droplets only. Tighten fastening bolts and recheck beginning of delivery.
Fig. 2-67

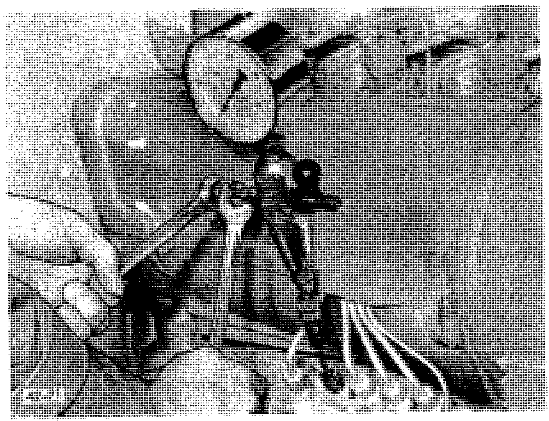
140



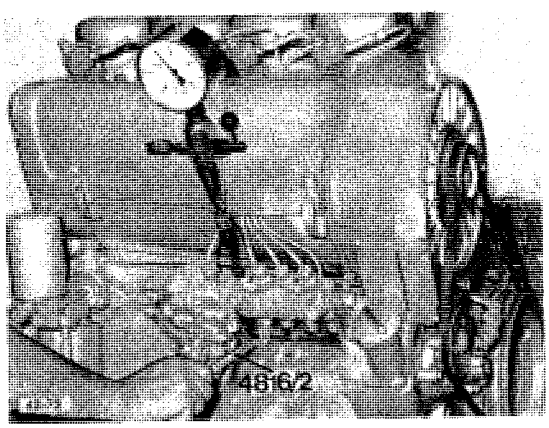
2-67



2-68



2-69



2-70

TESTING FUEL INJECTION PUMP

Special tools required:

Injection pump tester No. 3202
Pump lever .... No. 4816/2

The injection pump is tested on the engine to check the delivery valve and pump elements for tightness. Essential for the test is a satisfactory fuel supply system, free from air.

1. Detach injection line and mount test unit. Remove injection pump cover.
Fig. 2-68

2. Open second connection of test unit. Air-bleed injection pump and test unit. Reclose connection.
Fig. 2-69

112
113

3. Generate test pressures by pumping.

Note:

On F2L 912 with Deutz pump by turning the crankshaft.
Fig. 2-70

TESTING AND ADJUSTING INJECTOR
(with nozzle tester)

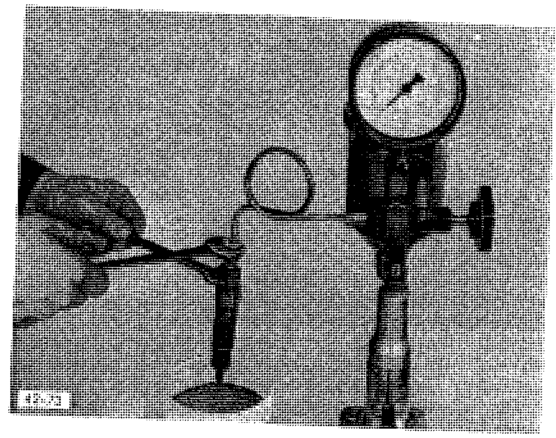
Note:

Strict cleanliness must be observed when working on the injection equipment. For testing the injectors, use only pur testing oil to ISO 4113 or clean diesel fuel.

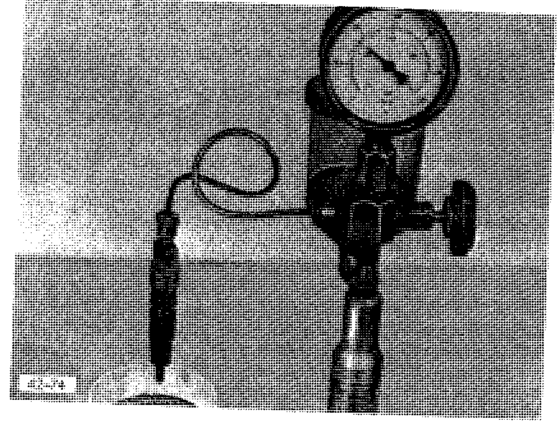
CAUTION:

Beware of injection nozzle fuel jet! The fuel penetrates deeply into the flesh, possibly resulting in blood poisoning.

1. Connect injector to testing outfit.
Fig. 2-71



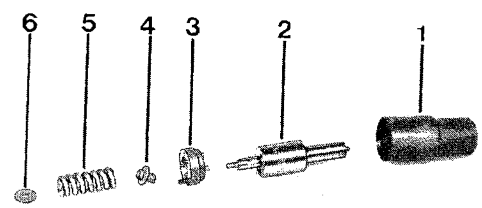
2-71



2-72

2. Checking the opening pressure:

With pressure gauge connected, slowly press down lever of testing outfit. The pressure at which the gauge pointer stops or suddenly drops, i.e. the highest pressure attained, is the opening pressure.
Fig. 2-72



42-75

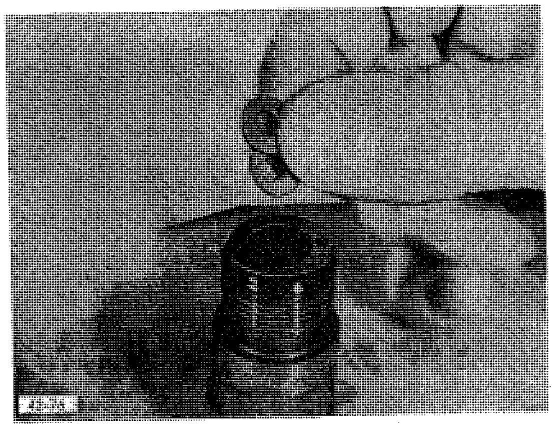
2-73

3. Adjusting the opening pressure of injector (direct injection engine):

Clamp injector between soft-metal cheeks in vice. Undo nozzle cap nut, remove all parts.

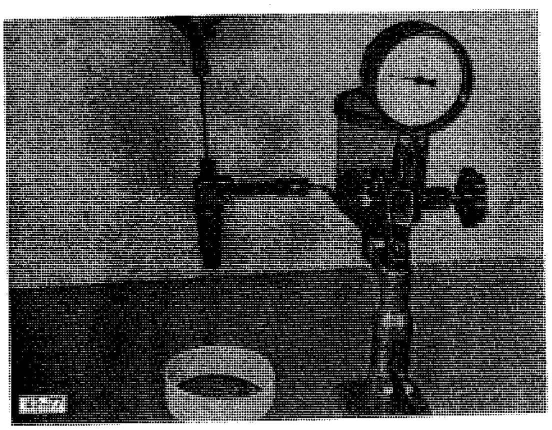
Sequence of disassembly of parts:

1) Cap nut 2) Injection nozzle, consisting of nozzle body and nozzle needle 3) Intermediate piece 4) Thrust cap 5) Compression sprin 6) Shims
Fig. 2-73



2-74

4. Adjust the pressure by selecting appropriate shims. Original shims in thicknesses from 1 - 1.95 mm, in steps of 0.05 mm, are available. A thicker shim pack increases the opening pressure. Reassemble injector and recheck on testing outfit.
Fig. 2-74

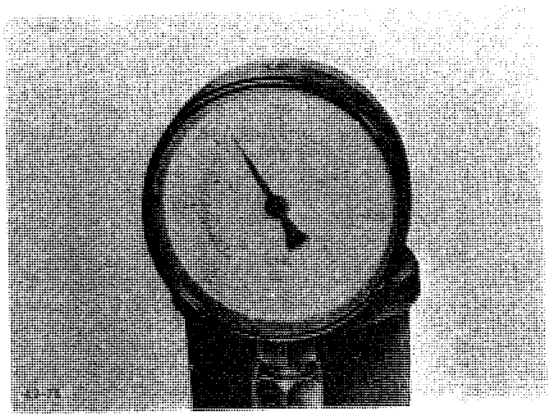


2-75

133

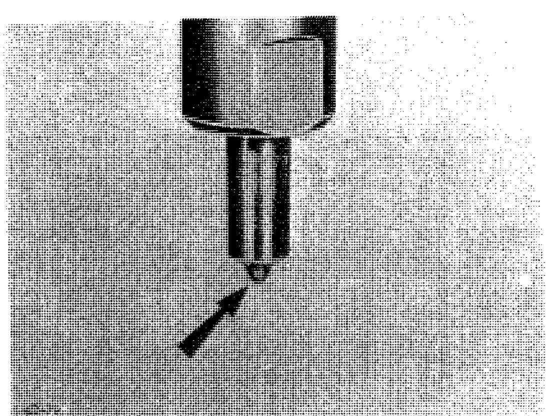
5. Adjusting the opening pressure of injector (engine with two-stage combustion):

The opening pressure is adjusted by means of a setscrew. By turning in screw, pressure is increased, and vice versa.
Fig. 2-75



2-76

6. Checking for tightness: Dry nozzle and nozzle holder with compressed air. Slowly press down handlever of testing outfit until a pressure of about 20 bars below the previous opening pressure reading is attained. The nozzle is tight if there is no dripping within a period of 10 seconds.
Fig. 2-76



2-77

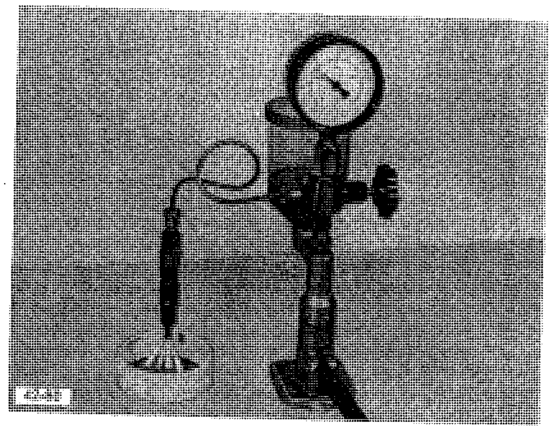
7. In the case of a drip, the injector must be dismantled and cleaned to remedy the leak. If this does not cure the leak, the nozzle must be renewed. Reworking is not admissible.
Fig. 2-77

8. Buzzing and spray pattern test:

Note:

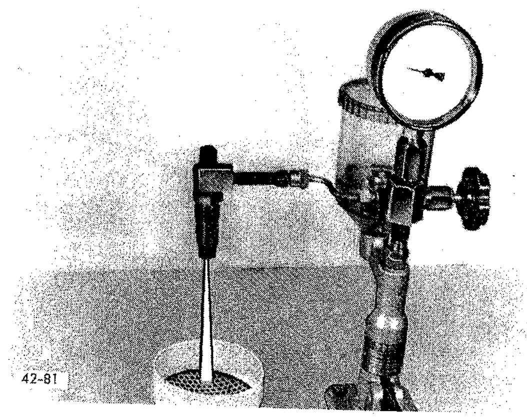
Disconnect pressure gauge from testing outfit.

The buzzing test permits an audible check of the ease of movement of the nozzle needle in the nozzle body. New injectors emit a different buzzing sound as compared with used injectors. It deteriorates due to wear in the needle seat zone. If an injection nozzle does not buzz despite cleaning, it should be replaced by a new one.
A used injector should buzz clearly during rapid actuation of the handlever, while exhibiting a well atomized spray pattern. The spray pattern can differ noticeably from that of a new injector.
Spray pattern (direct injection engine):
Fig. 2-78



2-78

Spray pattern (engine with two-stage combustion):
Fig. 2-79



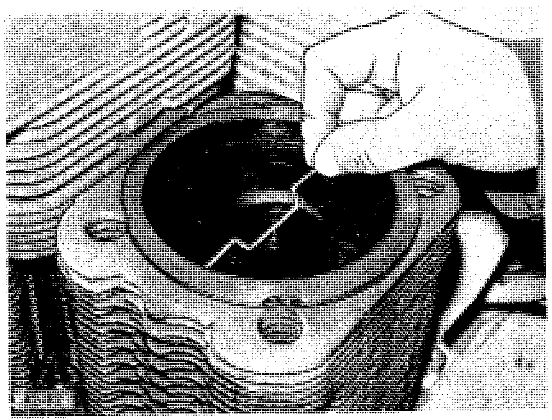
2-79

CHECKING AND ADJUSTING PISTON CROWN CLEARANCE

The cylinder head is removed.

Special tool required:

Socket wrench .... No. 120040

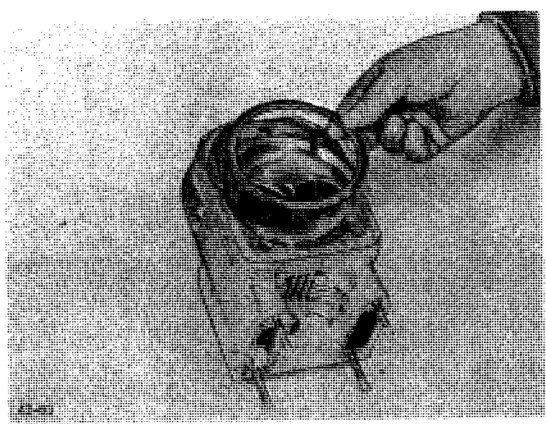


2-80

1. Affix a 2 mm gauge lead wire with grease to the piston crown.

Note:

The piston must be below TDC.
Fig. 2-80

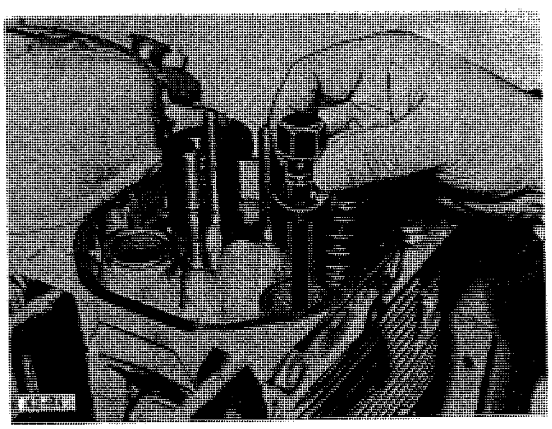


2-81

2. Affix sealing ring with grease to cylinder head bottom.

Note:

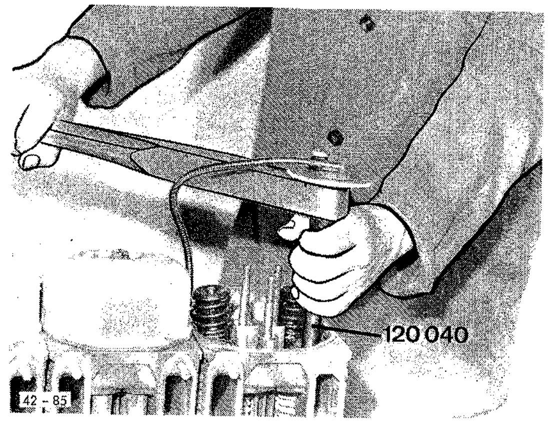
Earlier types of cylinder head have no sealing ring.
Fig. 2-81



2-82

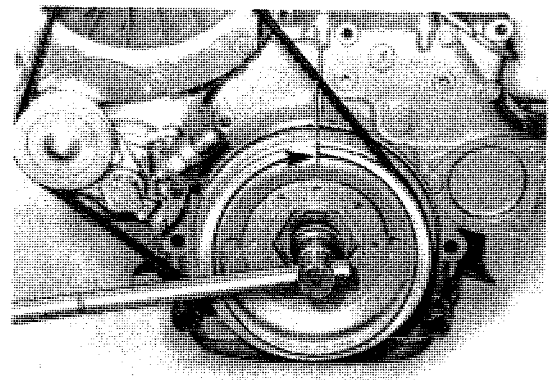
3. Mount cylinder head. Insert cylinder head bolts, complete with washers, with threads lightly oiled.
Fig. 2-82

4. Preload cylinder head bolts corrs-wise "hand-tight", then tighten finally with 45°.
Fig. 2-83



2-83

5. Turn crankshaft one rotation (360°).
Fig. 2-84

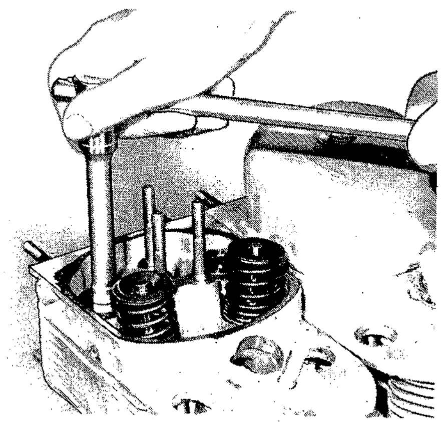


42-86

2-84

6. Remove cylinder head.
Fig. 2-85

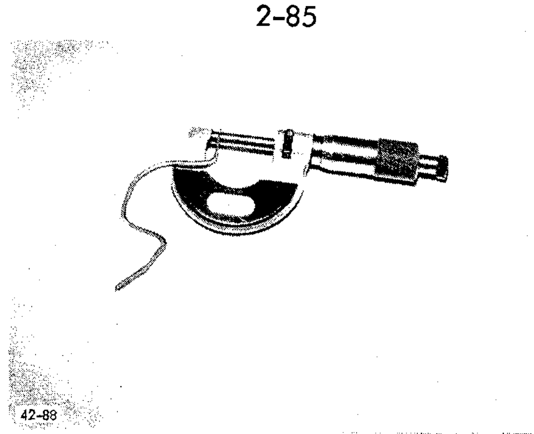
42-87



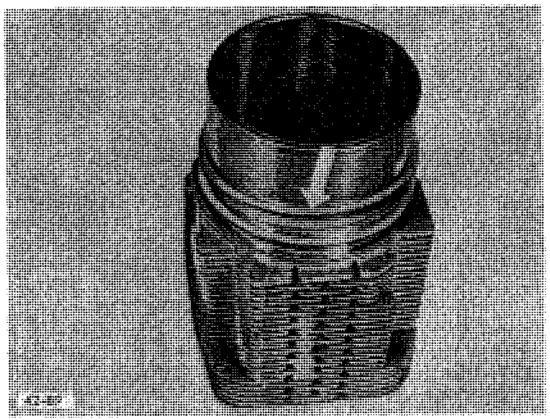
2-85

7. Measure lead wire at the thinnest point to determine piston crown clearance.
Fig. 2-86

404

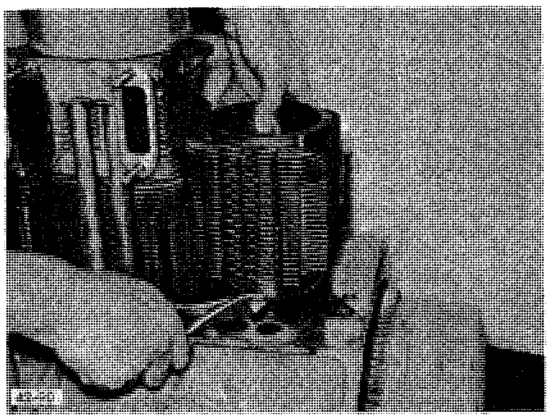


2-86



2-87

8. Correct the piston crown clearance as follows: If the cclearance is too small, remove cylinder and place shim of appropriate size underneath it.
Fig. 2-87

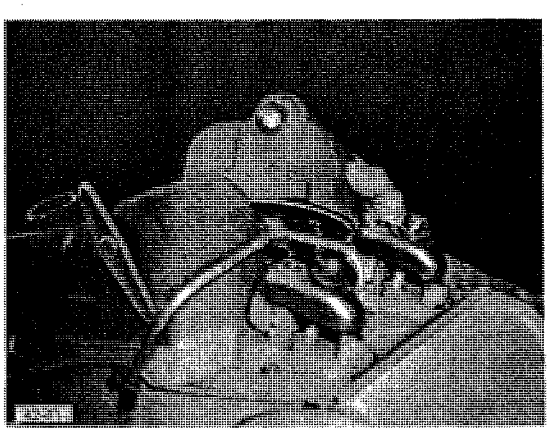


2-88

- If the clearance is too large, lift up the cylinder a little and cut through shim of appropriate size with side-cutting pliers to permit its removal.

Note:

Available for correcting the piston crown clearance are shims of 0.2; 0.3; 0.5; 08; and 1.0 mm thickness. In the case of shim-pack heights of 0.5 mm and over, a 0.5 mm thick shim should be used instead of several shims of 0.2 mm thickness.
At least one shim should be provided underneath the cylinder for sealing purposes.
Fig. 2-88



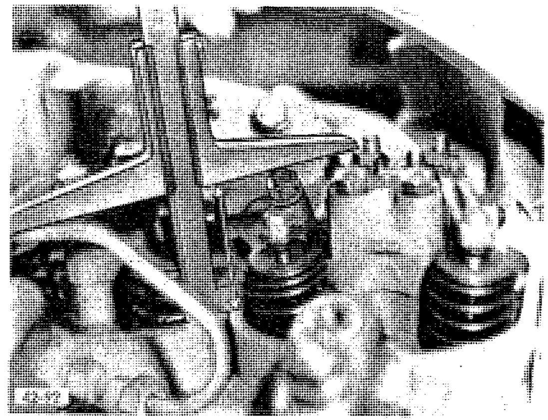
2-89

CHECKING AND ADJUSTING DECOMPRESSION DEVICE (F2L 912)

1. Remove rocker chamber covers.
Fig. 2-89

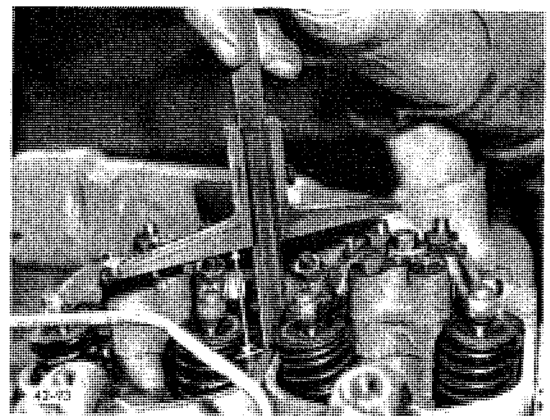
2. Inlet valve of cylinder I must be closed. Check dimension from sealing surface to top edge of setscrew for decompression device. Specified dimension: 59.7 $^{+0.2}$ mm.
Fig. 2-90

In case of deviations from the specified dimension, correct by means of setscrew.



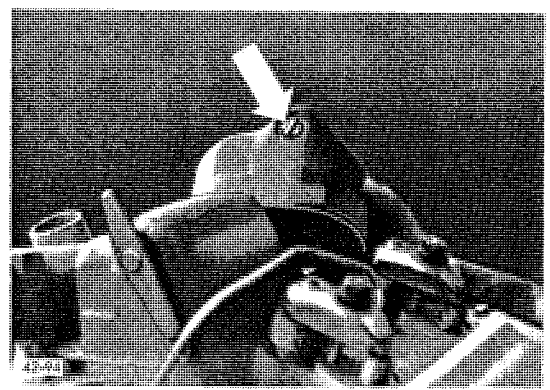
2-90

3. Exhaust valve of cylinder 2 must be closed. Repeat measurement as described under para. 2.
Fig. 2-91



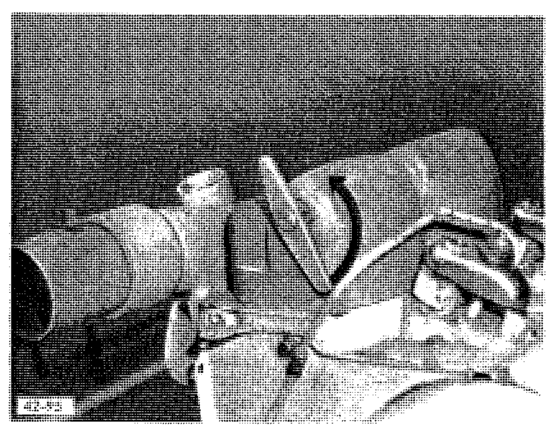
2-91

4. Fit rocker chamber covers in place, while making sure that the driver of cylinder 2 decompression shaft engages in the slot of cylinder I decompression shaft.
Fig. 2-92

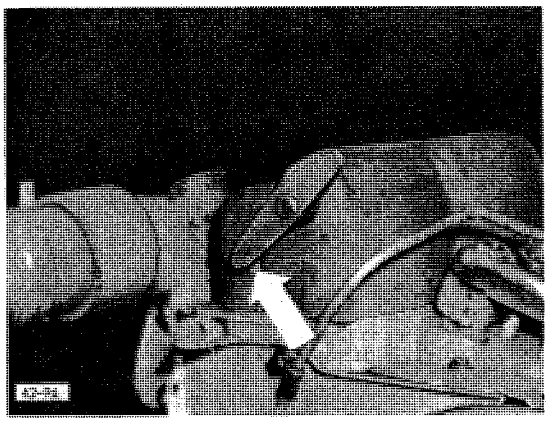


2-92

5. Position of control lever when decompression device is switched off:
Fig. 2-93



2-93



2-94

6. To operate the decompression device, turn the control lever in direction of arrow as far as it will go.
Fig. 2-94

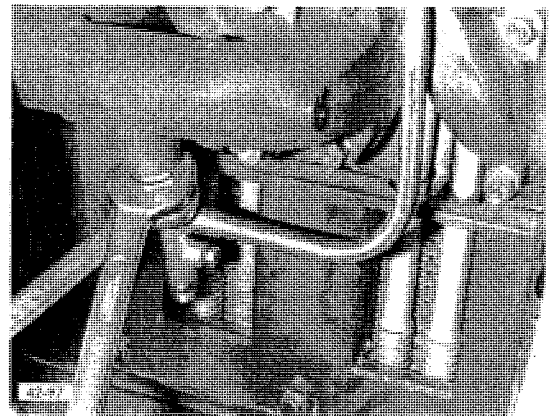
CAUTION:

In case of improper use, danger of accident due to rebound of engine starting handle!

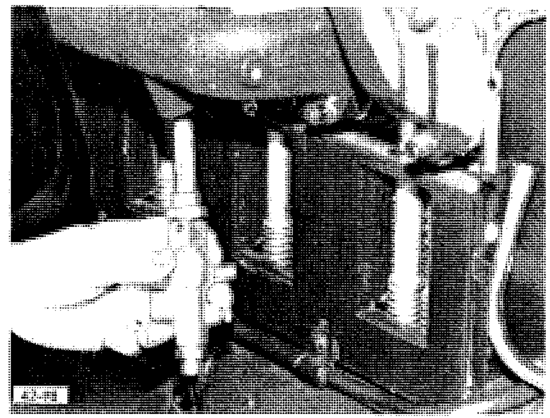
REMOVING AND INSTALLING EXHAUST THERMOSTAT

REMOVING:

1. Unscrew oil pressure lines and venting line, loosen lock nut.
Fig. 2-95


2-95

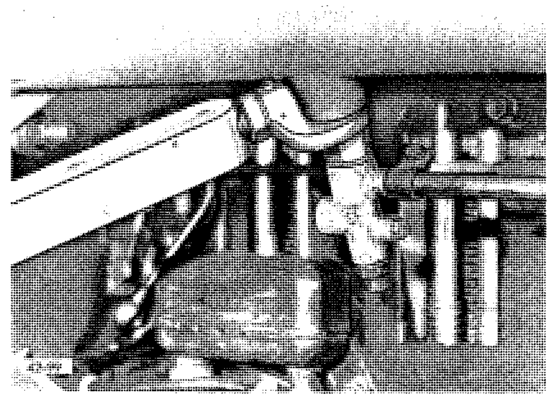
2. Screw thermostat out of exhaust manifold.
Fig. 2-96


2-96

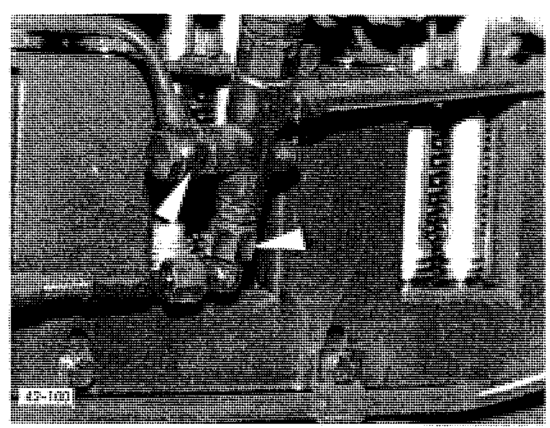
INSTALLING:

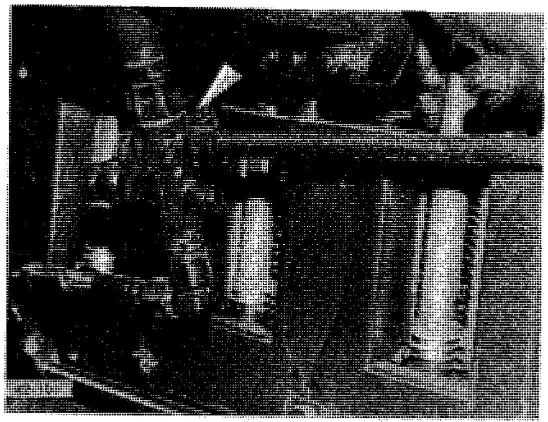
3. Apply film of Deutz S I Never-Seize Paste to thread of thermostat.

4. Screw thermostat into exhaust manifold, line up with connection for vent line. Tighten lock nut (20 - 30 Nm).
Fig. 2-97

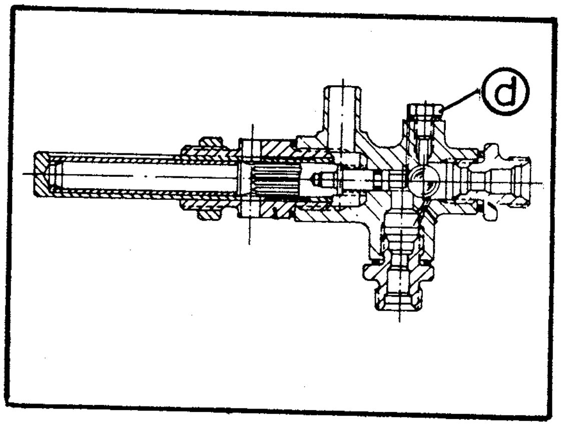

2-97

5. Screw on oil pressure lines, free from stress.
Fig. 2-98


2-98


2-99

6. Tighten clip for vent line.
Fig. 2-99

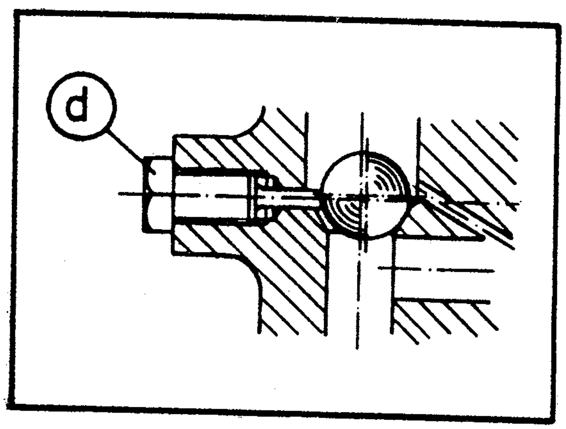


2-100

TESTING EXHAUST THERMOSTAT

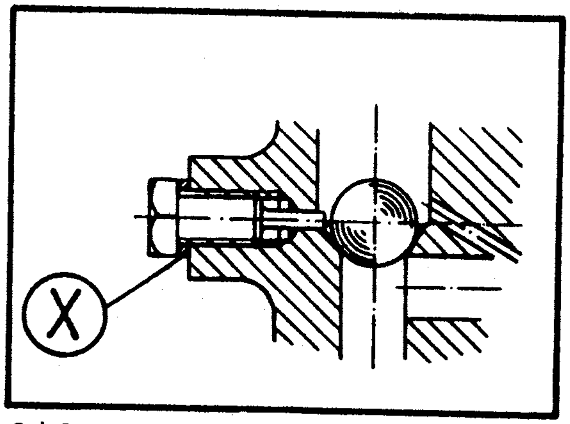
Test with engine loaded

If the pilot lamp for engine temperature lights up on engines equipped with exhaust thermostat, the thermostat has to be bypassed. Stop engine and remove the special copper sealing ring "X" under the setscrew "d". The thermostat is thus switched over to full flow, i.e., the cooling blower operates uncontrolled. If the cooling blower is now heard to run at higher speed and the pilot lamp no longer lights up, the exhaust thermostat is faulty and must be checked over.
Fig. 2-100



2-101

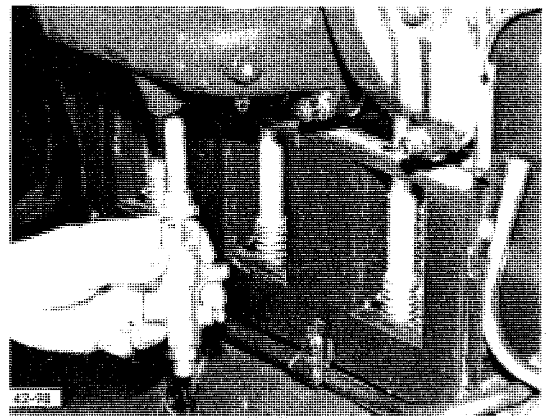
Exhaust thermostat without special copper sealing ring has no controlling function.
Fig. 2-101



2-102

Exhaust thermostat fitted with special copper sealing ring "X" has controlling function.
Fig. 2-102

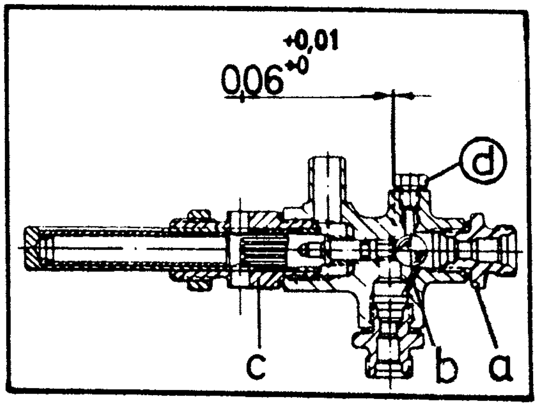
Remove exhaust thermostat.
Fig. 2-103


2-103

DISMANTLING AND ADJUSTING EXHAUST THERMOSTAT

Special tools required:

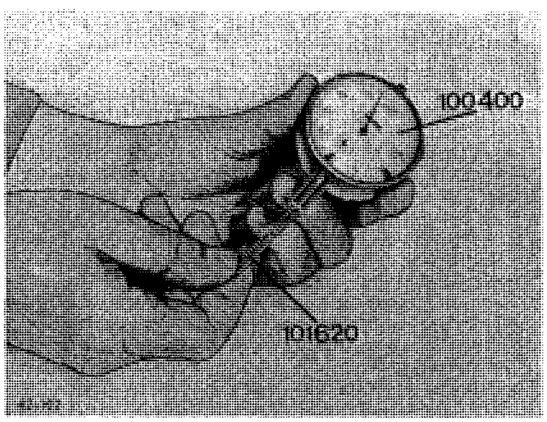
Dial gauge	No. 100400
Socket wrench	No. 101600
Dial gauge holder	No. 101610
Extension pin	No. 101620
Feeler gauge	No. 101630



2-104

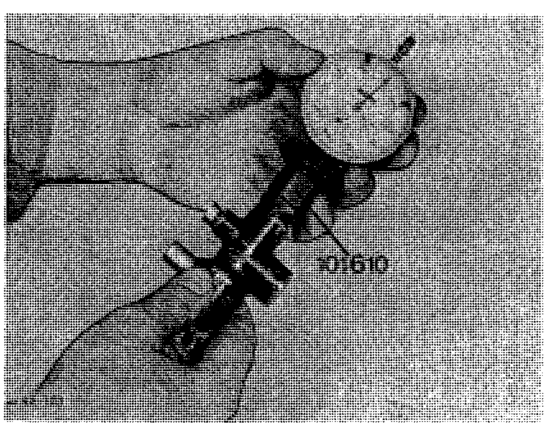
Screw out the adapter nipple "a", clean the ball seat and idling bore "b", then refit the adapter nipple. The expansion pin housing "c" need not be screwed out for the time being. Clean out the blow-out bores and slots with compressed air. The specified clearance in the exhaust thermostat is $0.06^{+0.01}_{0}$ mm (see table on page 2/37) at the reference temperature of 20° C.

Deviations in the clearance can lead to engine operating troubles.
Fig. 2-104



2-105

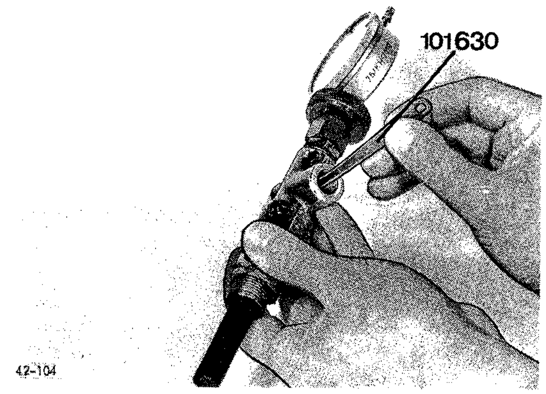
1. Screw extension pin onto dial gauge.
Fig. 2-105



2-106

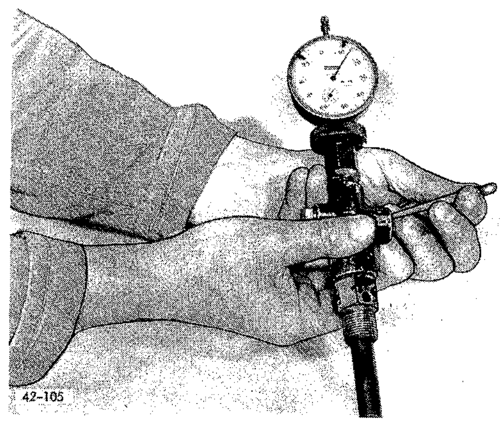
2. Screw on dial gauge c/w holder (preloaded), and set pointer to zero.
Fig. 2-106

7. Using feeler gauge, determine whether there is a clearance.
Fig. 2-107



2-107

4. If there is no clearance, the dial gauge reads 0.2 mm. If there is a clearance, the dial gauge pointer should indicate a reading below 0.2 mm. The clearance is the difference between the indicated value and 0.2 mm.
Fig. 2-108



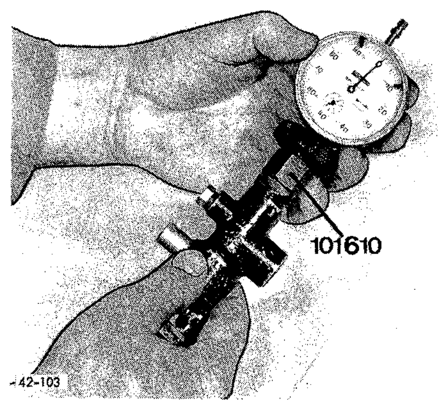
2-108

Example:

If the dial indication is 0.14 mm, the actual clearance is 0.06 mm. If the dial indication is 0.11 mm, the clearance is 0.09 mm. In this case, the shim "c" must be 0.03 mm thinner, in order to give the prescribed clearance of

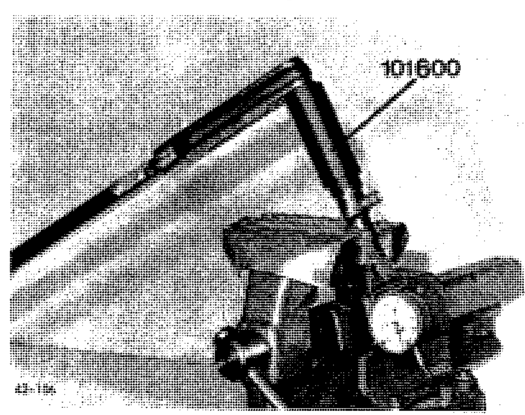
$$0.06^{+0.01}_{\;0} \text{ mm.}$$

If the clearance is too small, select a shim of appropriate thickness. Before carrying out each measurement, make sure that the pointer of the dial gauge is at zero position.
Fig. 2-109

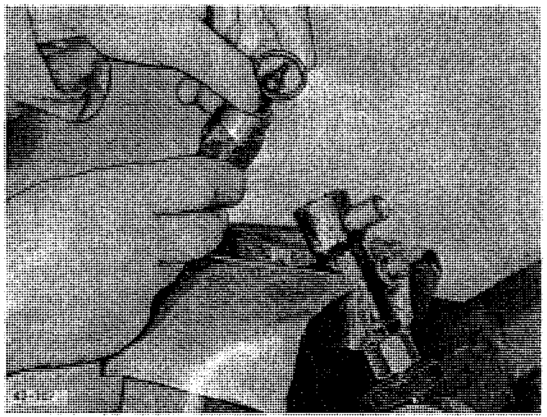


2-109

5. Screw out expansion pin housing.
Fig. 2-110



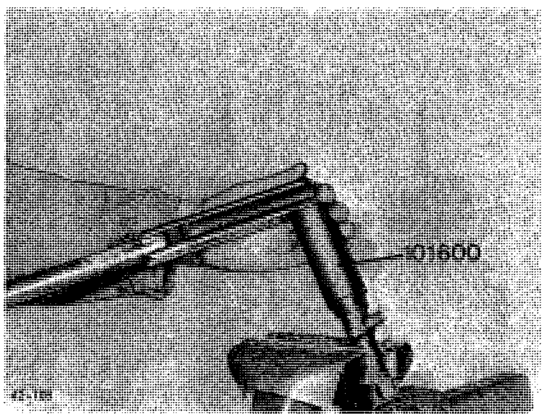
2-110



2-111

6. The correct the clearance, select appropriate shim.
Fig. 2-111

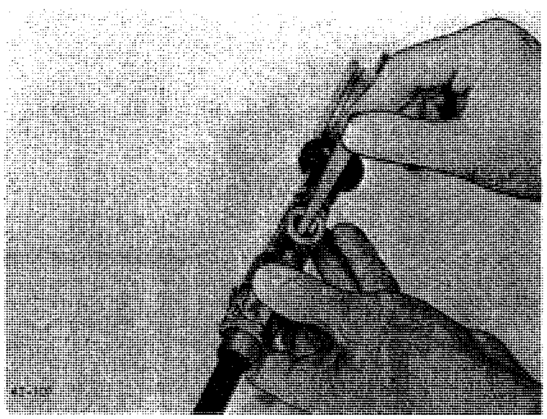
7. Screwing in and tightening the expansion pin housing in the upper part of the thermostat is done as follows:
- Lightly oil thread of expansion pin housing and then screw in. Tighten with torque wrench to 50 Nm, then loosen again.
- Retighten to 50 Nm, then loosen once more.
- Retighten finally to 50 Nm.



2-112

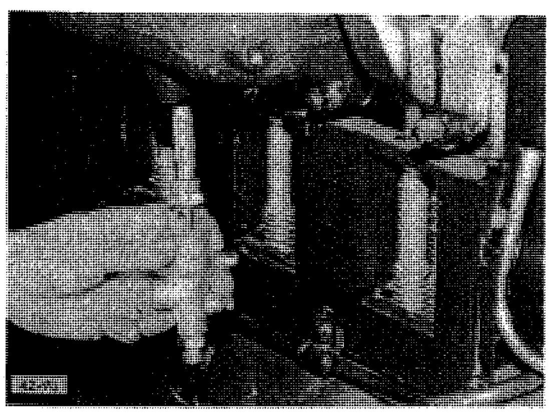
Note:

This tightening and loosening procedure is necessary to ensure proper settling of the shim, thus preventing any later influence on the clearance.
Fig. 2-112



2-113

8. Recheck clearance.
Fig. 2-113

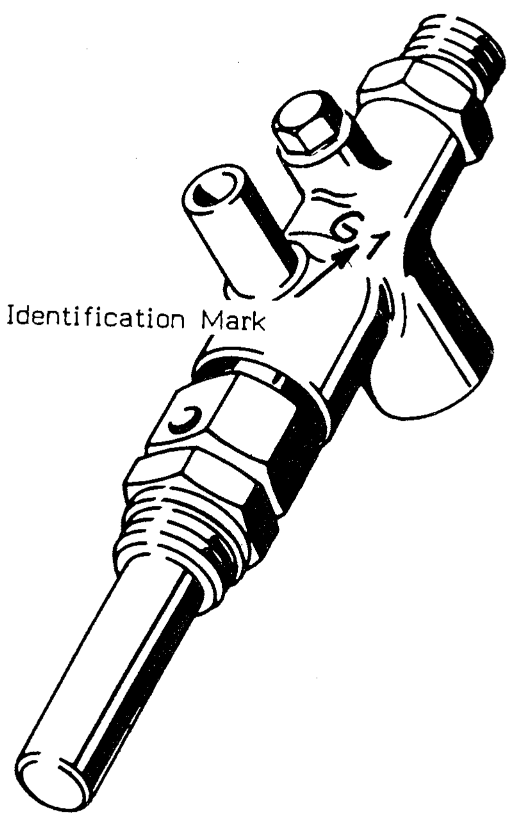


2-114

9. Before refitting the thermostat into the exhaust manifold, rub DEUTZ SI Never-Seize Paste into the thread of the thermostat. Tighten the lock nut only up to 20-30 Nm.
Fig. 2-114

EXHAUST THERMOSTATS

Type	Identification Mark	Set Clearance "S" (Tolerance + 0.01)
V23 223 8594	C 6	0,02
V24 223 8595	G 1	0,02
V26 223 8597	G 2	0,06
V27 223 9876	C 9	0,02
V29 415 1314	G 4	0,02



Index

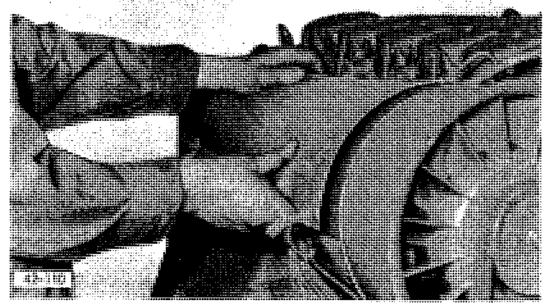
3. Cylinder Unit

REMOVING AND REFITTING CYLINDER HEAD

Special tools required:

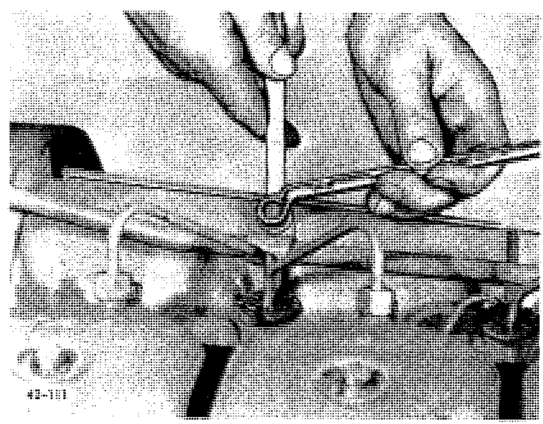
Extractor .... No. 110030
Screw fitting .... No. 110050
Socket wrench .... No. 120040
Spring compressing
tool .... No. 125310
Puller .... No. 150800

1. Remove air cowling.
Fig. 3-1



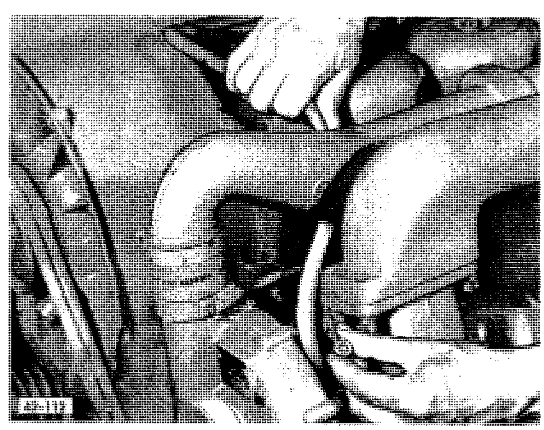
3-1

2. Remove pipe clips at lube oil line leading to turbocharger.
Fig. 3-2

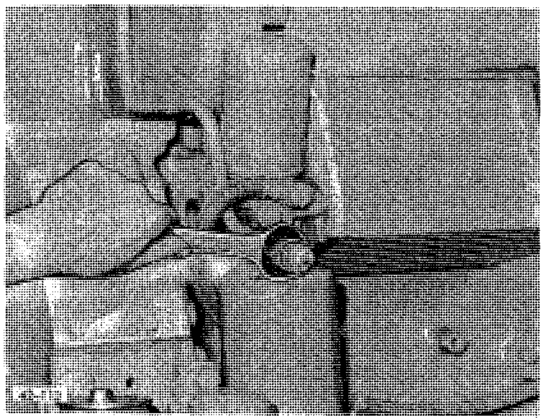


3-2

3. Remove lube oil line at turbocharger. -
Fig. 3-3

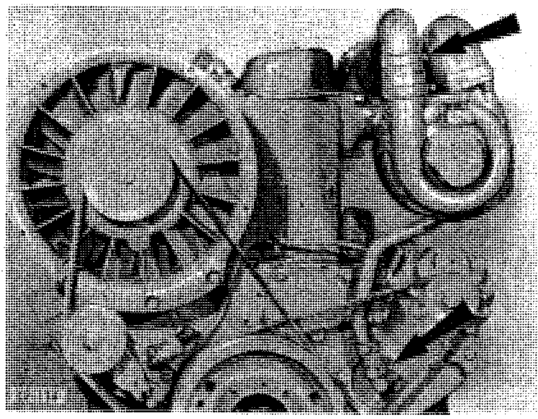


3-3



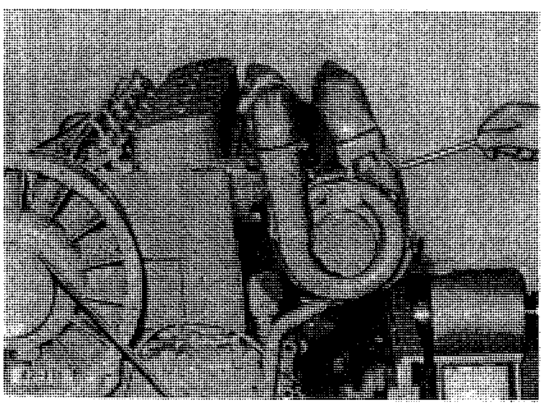
3-4

- and at filter bracket.
Fig. 3-4



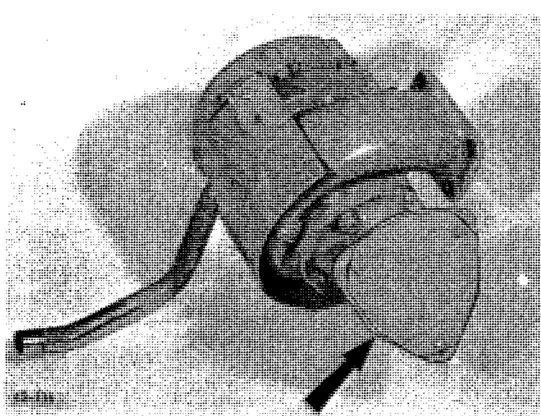
3-5

4. Loosen hose clips at turbocharger and at oil return pipe.
Fig. 3-5



3-6

5. Undo bolts at flange of turbocharger. -
Fig. 3-6



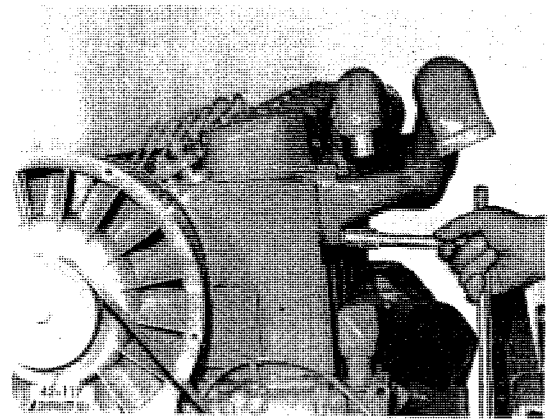
3-7

- and take off turbocharger.

Note:

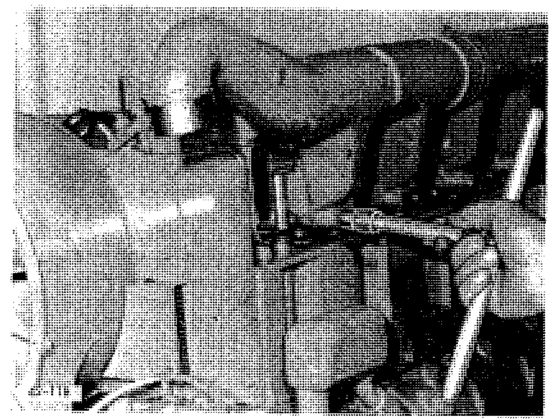
Close flange at bend of turbocharger.
Fig. 3-7

6. Remove exhaust manifold.
Fig. 3-8



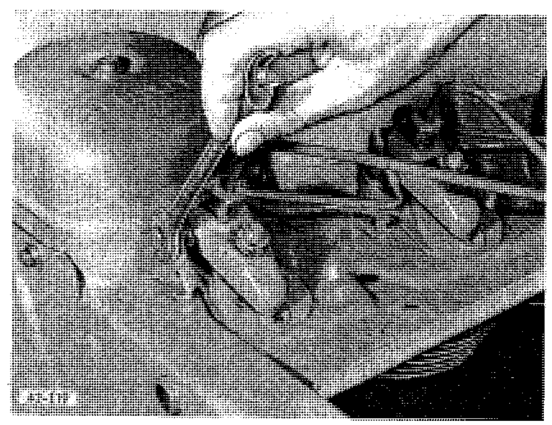
3-8

7. Remove air intake manifold.
Fig. 3-9



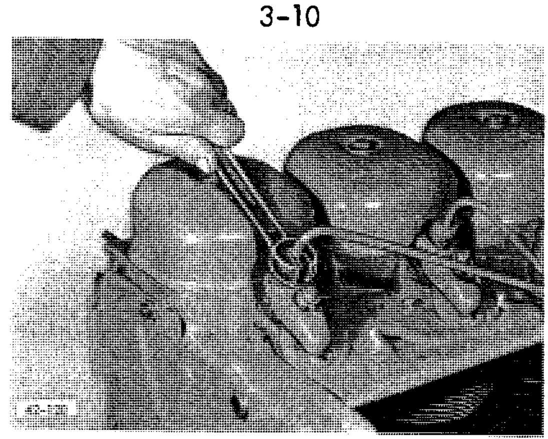
3-9

8. Detach backleakage line.
Fig. 3-10

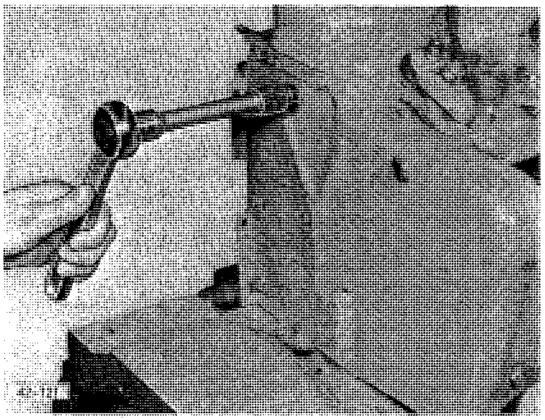


3-10

9. Undo injection lines.
Fig. 3-11

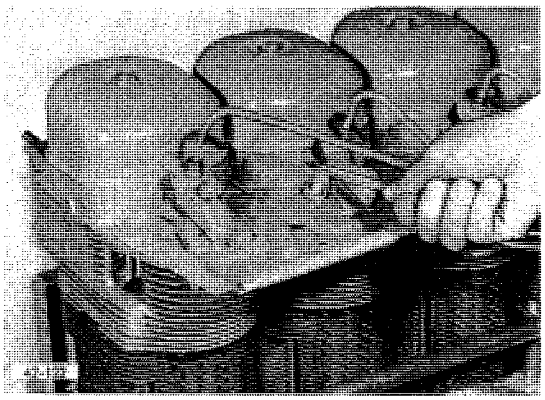


3-11



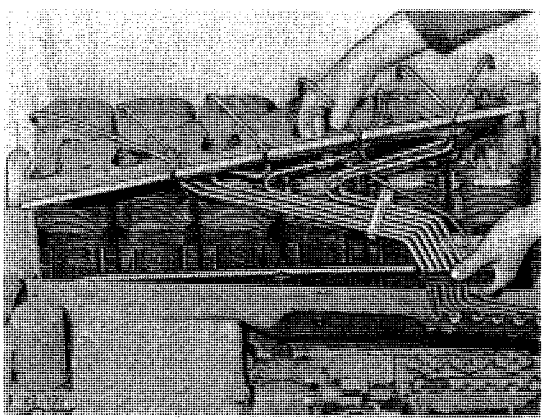
3-12

10. Remove rear stay plate.
Fig. 3-12



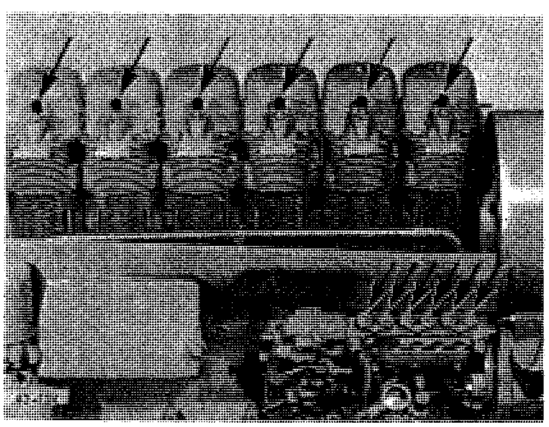
3-13

11. Remove upper cover plate.
Fig. 3-13



3-14

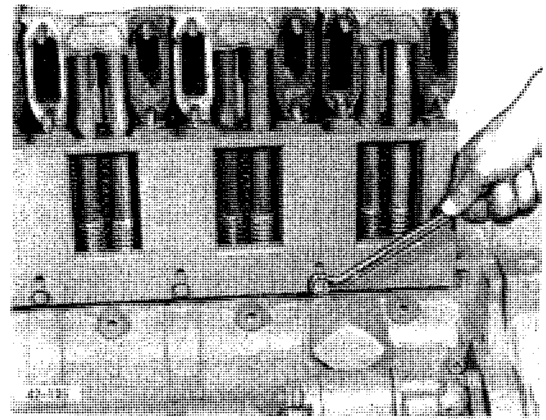
12. Lift off upper cover plate together with the injection lines and backleakage line.
Fig. 3-14



3-15

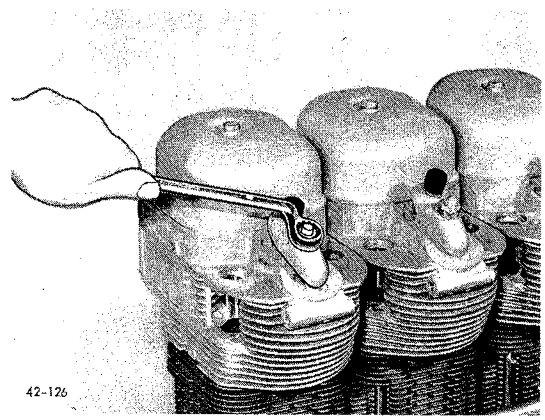
13. Close injectors and injection pump with protective caps.
Fig. 3-15

14. Mount cover plate on air discharge side.
Fig. 3-16



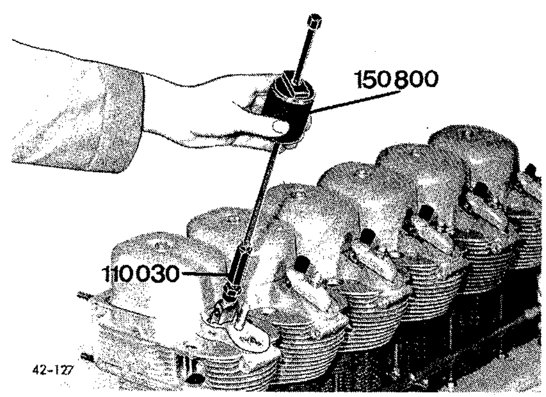
3-16

15. Remove clamping bridge.
Fig. 3-17



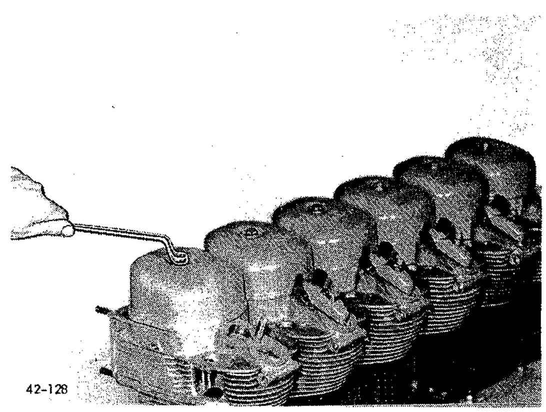
3-17

16. Remove injector.
Fig. 3-18

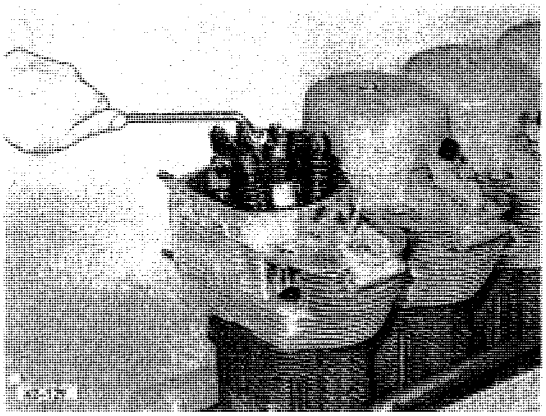


3-18

17. Remove rocker chamber cover.
Fig. 3-19

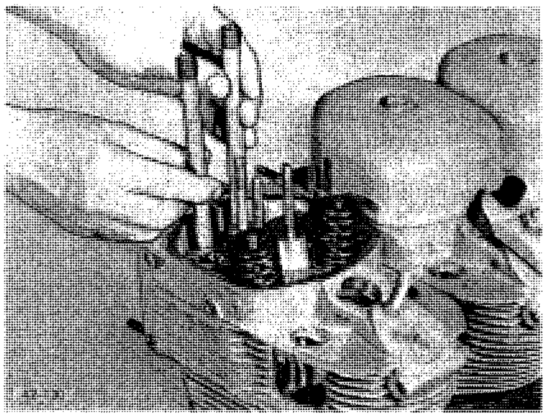


3-19



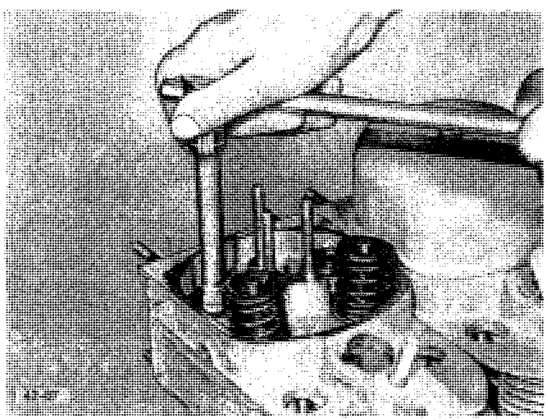
3-20

18. Remove rocker arm bracket.
Fig. 3-20



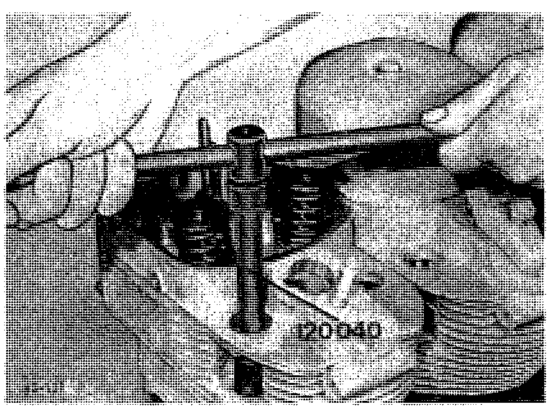
3-21

19. Take out pushrods.
Fig. 3-21



3-22

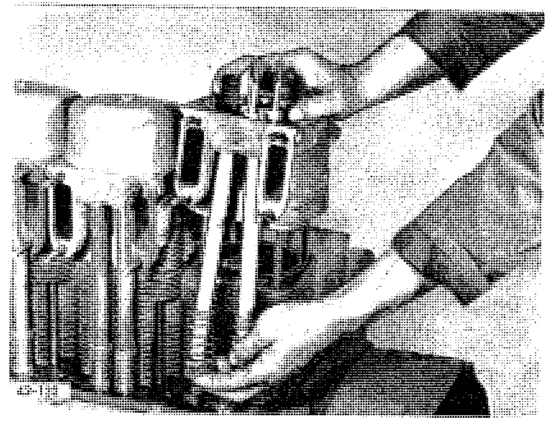
20. Screw out plugs.
Fig. 3-22



3-23

21. Release cylinder head bolts corss-wise and remove.
Fig. 3-23

22. Take off cylinder head together with pushrod cover tubes.
Fig. 3-24

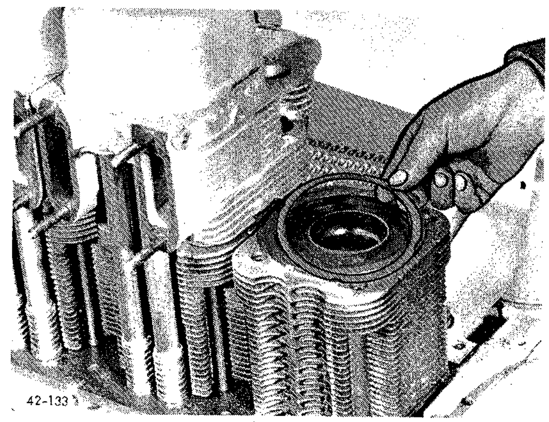


3-24

23. Remove sealing ring.

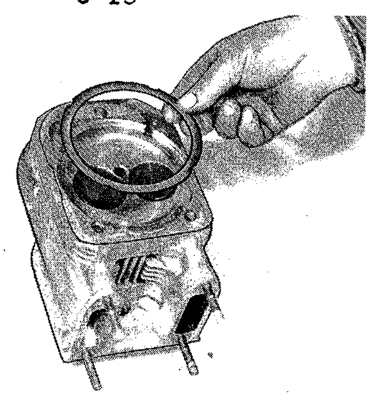
Note:

Earlier types of cylinder head have no sealing ring.
Fig. 3-25



3-25

24. Affix sealing ring with a little grease to cylinder head.
Fig. 3-26



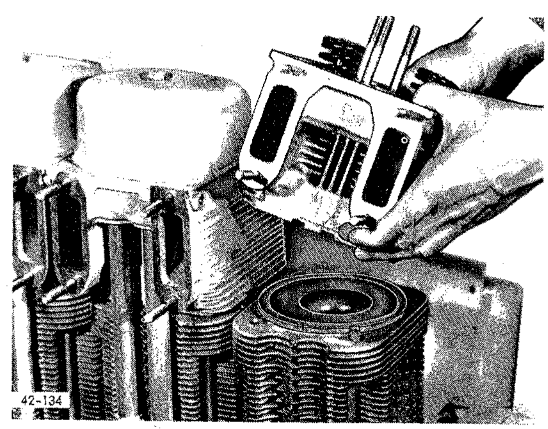
42-83

3-26

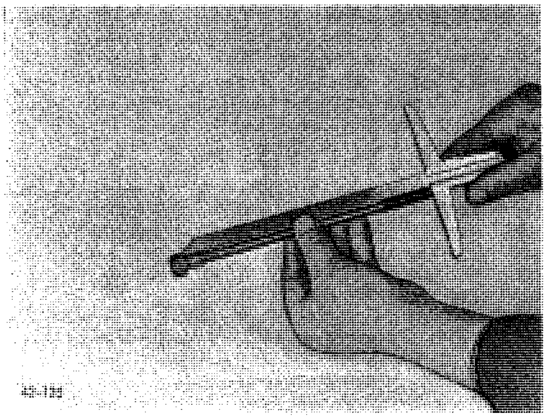
25. Position cylinder head.

Note:

Should work on the head have possibly affected the piston crown clearance, remeasure clearance. See Chapter 2.
Fig. 3-27

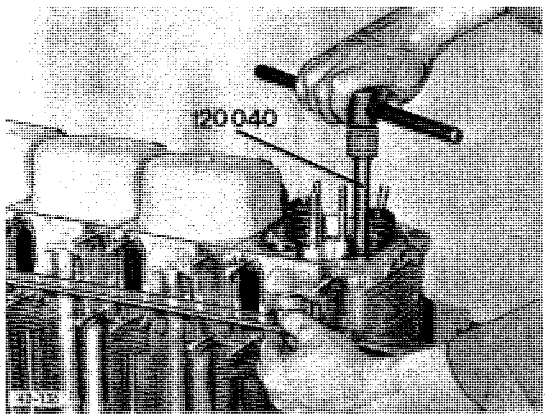


3-27

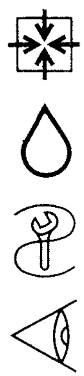


3-28

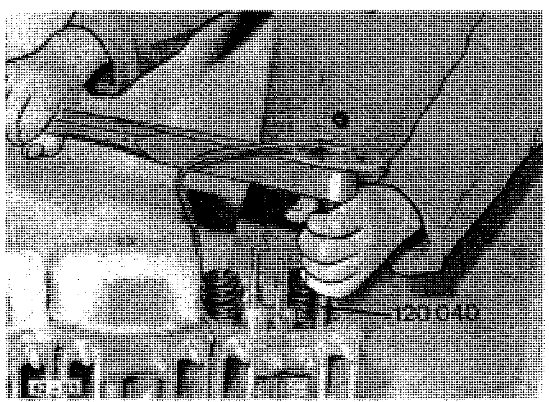
26. Before reassembly, check whether the cylinder head bolts are fit for reuse. Measure bolt length.
Fig. 3-28



3-29

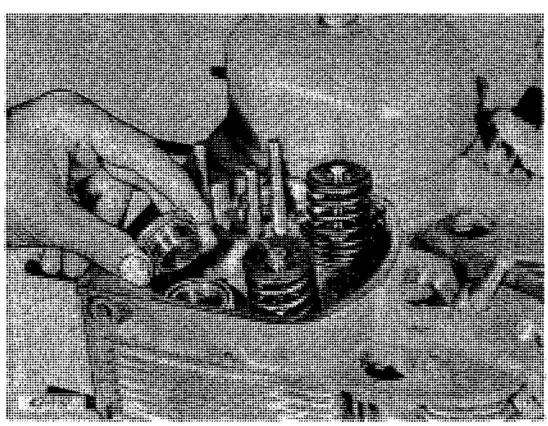


27. Insert cylinder head bolts, c/w washers, with threads lightly oiled. Align cylinder heads.
Fig. 3-29



3-30

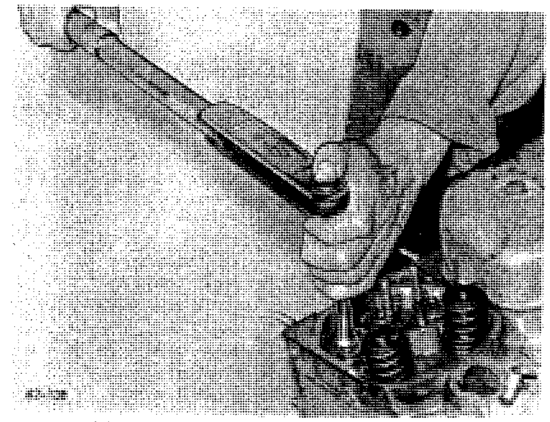
28. Tighten cylinder head bolts as specified.
Fig. 3-30



3-31

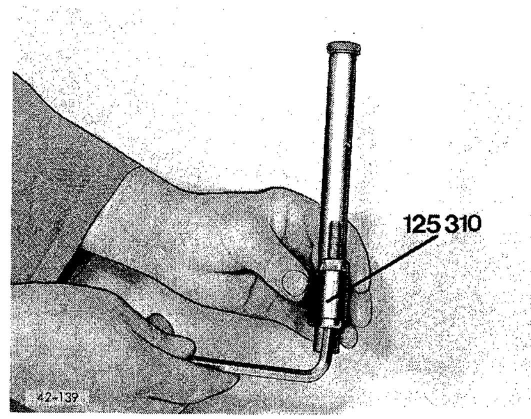
29. Screw in plugs provided with new sealing rings.
Fig. 3-31

30. Tighten plugs as specified.
Fig. 3-32



3-32

31. Fit spring on pushrod cover tube and compress with special tool.
Fig. 3-33



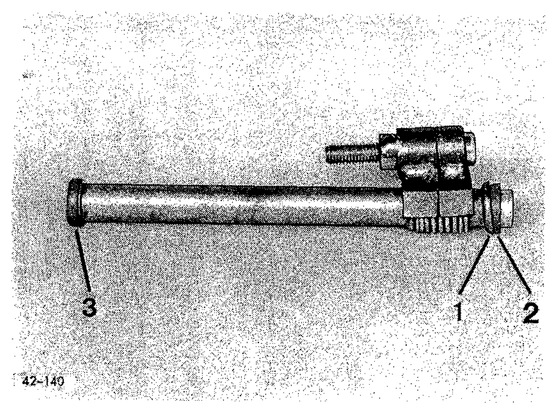
3-33

32. Preassemble pushrod cover tube c/w new profile seals.

Assembly sequence:

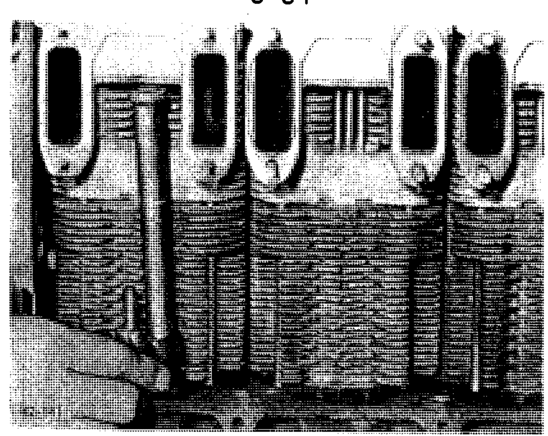
1. Profile washer
2. Lower profile seal
3. Upper profile seal

Fig. 3-34

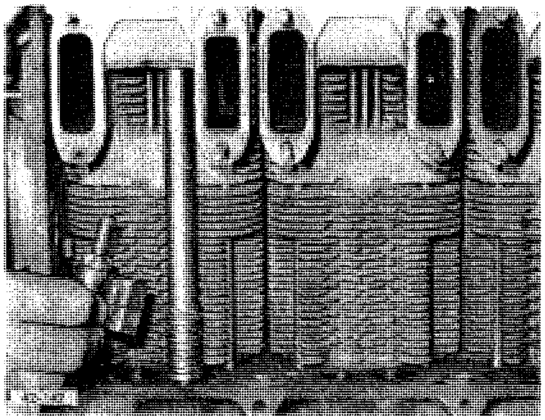


3-34

33. Introduce tube first into the crankcase.
Fig. 3-35, -



3-35



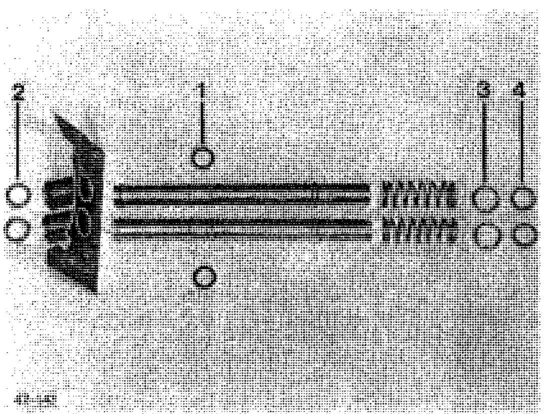
3-36

- and then into the cylinder head. Withdraw spring compressing tool.
Fig. 3-36

REFITTING PUSHROD COVER TUBES ON ENGINES WITH AIR-TO-AIR HEATING SYSTEM

Speical tools required:

Spring compressing
tool 2x .... No. 125310



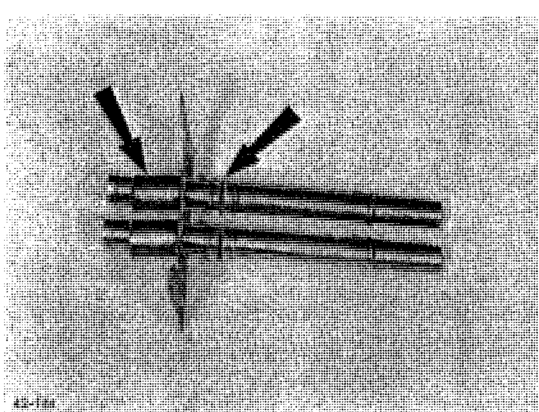
3-37

34. Preassemble pushrod cover tubes.

Assembly sequence:

1. O-rings
2. Upper profile seals
3. Profile washers
4. Lower profile seals

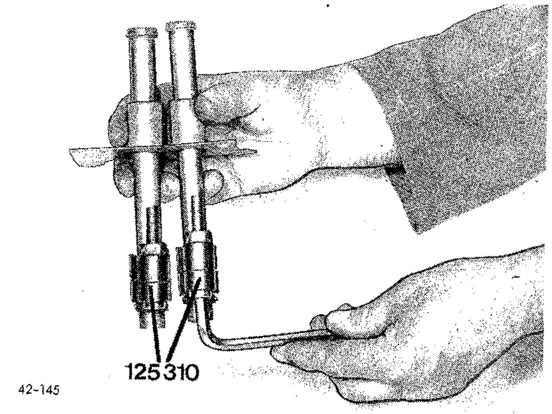
Fig. 3-37



3-38

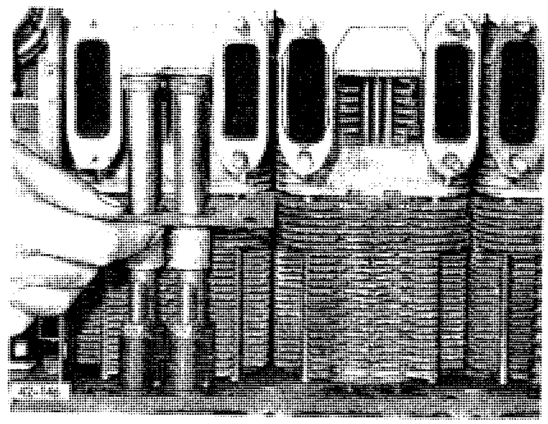
35. Install O-rings and push on cover plate.
Fig. 3-38

36. o Install upper profile seals.
o Fit springs and compress with sepcial tools.
o Install profile washers and lower profile seals.
Fig. 3-39



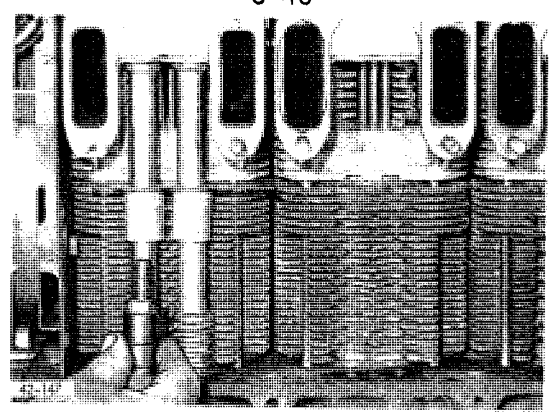
3-39

37. Introduce tubes first into the crankcase. -
Fig. 3-40



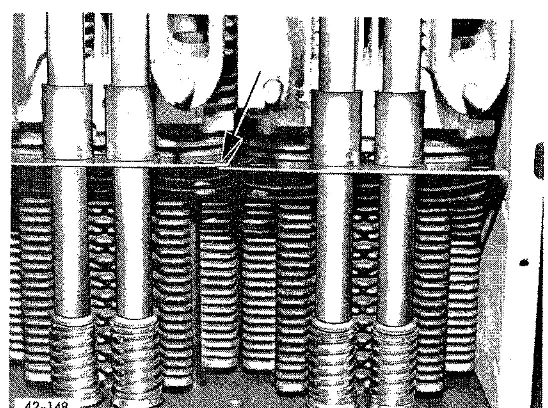
3-40

- and then into the cylinder head. Withdraw spring compressing tools.
Fig. 3-41

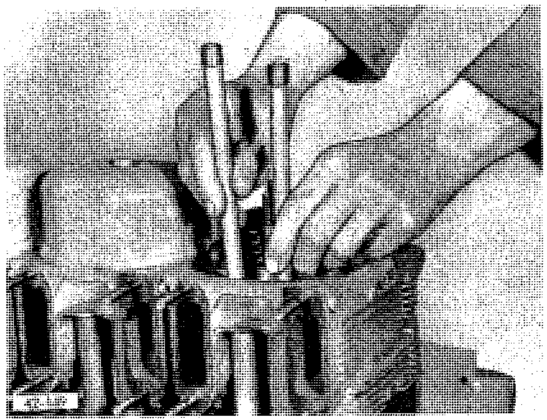


3-41

38. The cover plates must overlap.
Fig. 3-42

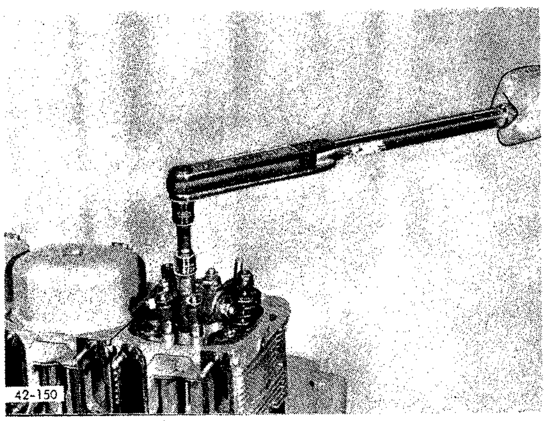


3-42



3-43

39. Insert pushrods.
Fig. 3-43

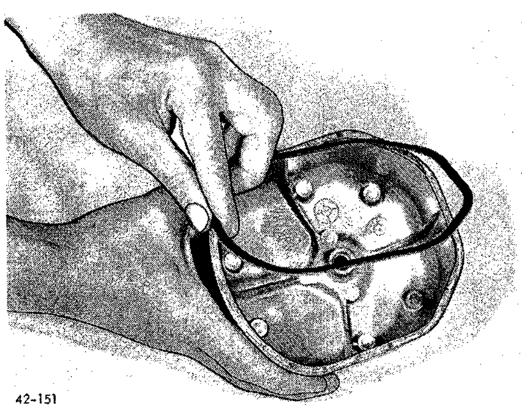


3-44

40. Fit rocker arm bracket. Tighten fastening nuts as specified.

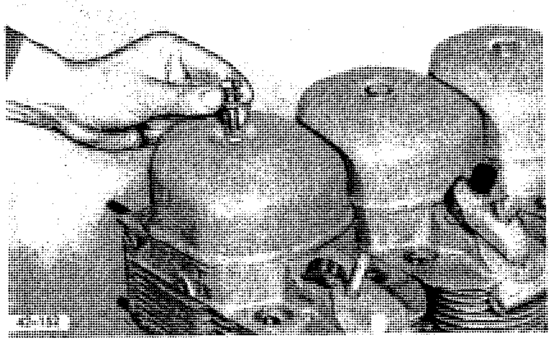
Note:

Set valve clearance (see Chapter 2).
Fig. 3-44



3-45

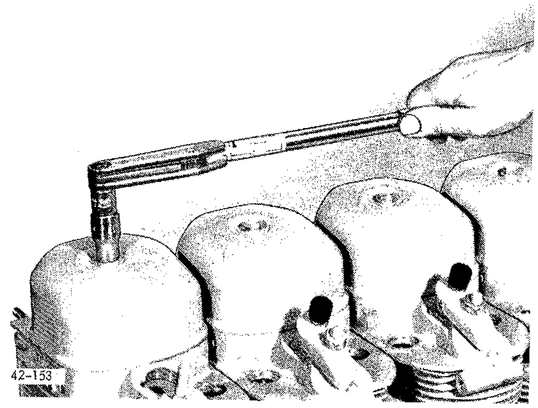
41. Affix gasket to rocker chamber cover with sealing compound (graphited surface facing towards cylinder head).
Fig. 3-45



3-46

42. Fit rocker chamber cover in place and insert fastening bolt c/w joint washer.
Fig. 3-46

43. Tighten fastening bolt as specified.
Fig. 3-47

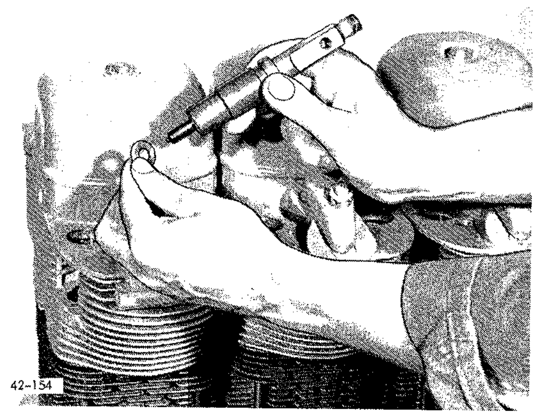


3-47

44. Install injector, after affixing special ring with a little grease on the graphited side onto the injector.

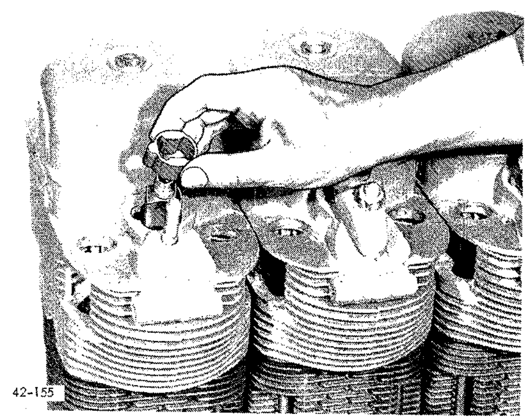
Note:

Injector for 2-stage combustion: See Chapter 7.
Fig. 3-48



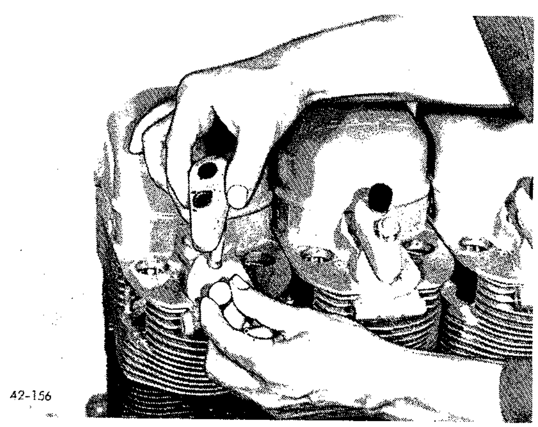
3-48

45. Fit injector centering piece.
Fig. 3-49

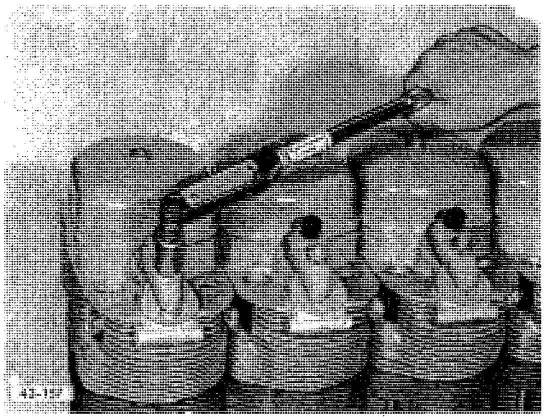


3-49

46. Locate thrust piece and clamping bridge.
Fig. 3-50

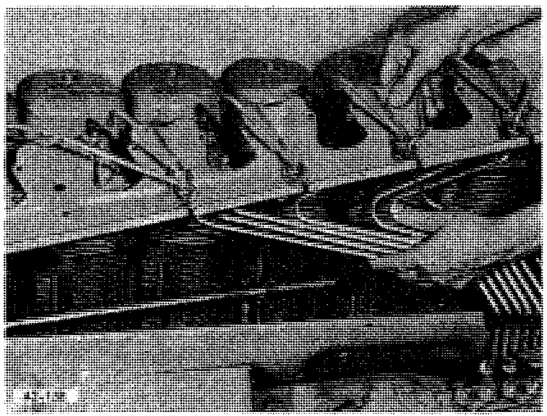


3-50



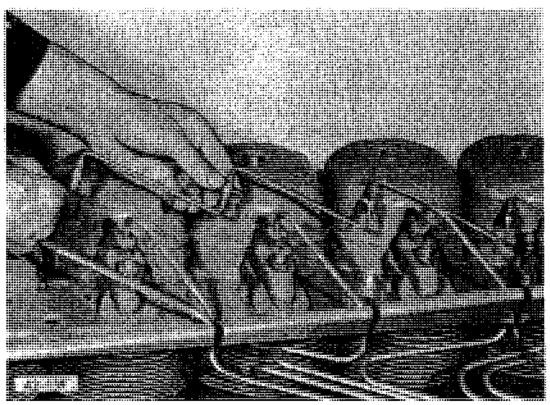
3-51

47. Screw on fastening nut and tighten as specified.
Fig. 3-51



3-52

48. Mount upper cover plate together with injection lines and backleakage line, and fix in place.
Fig. 3-52



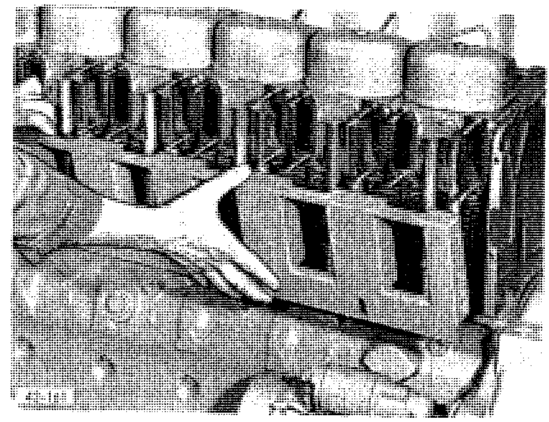
3-53

49. Fit backleakage line c/w banjo bolts and sealing rings onto the injectors.
Fig. 3-53

3-54

50. Mount stay plate at flywheel end.
Fig. 3-54

51. Mount cover plate on air discharge side.
Fig. 3-55

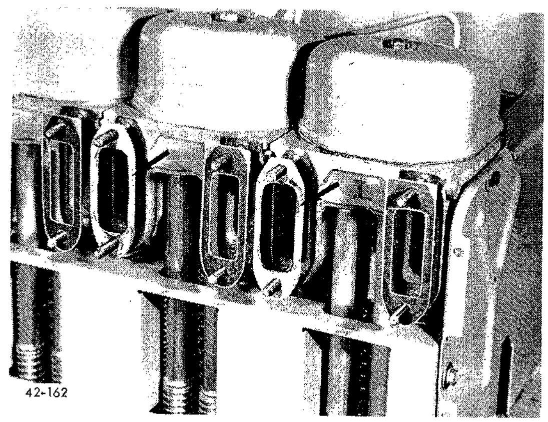


3-55

52. Fit gaskets for air intake and exhaust manifolds.

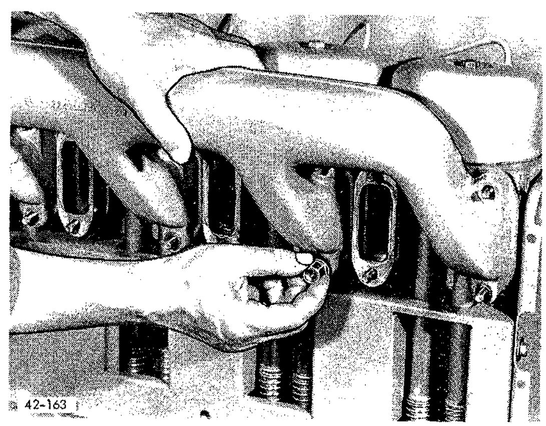
Note:

Install gaskets for exhaust manifold with knurled side away from the cylinder head.
Fig. 3-56



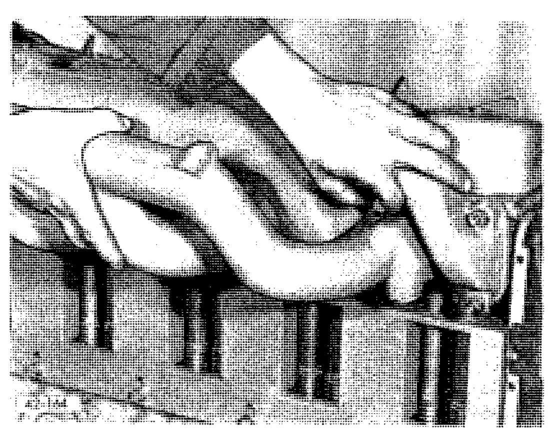
3-56

53. Mount air intake manifold.
Fig. 3-57

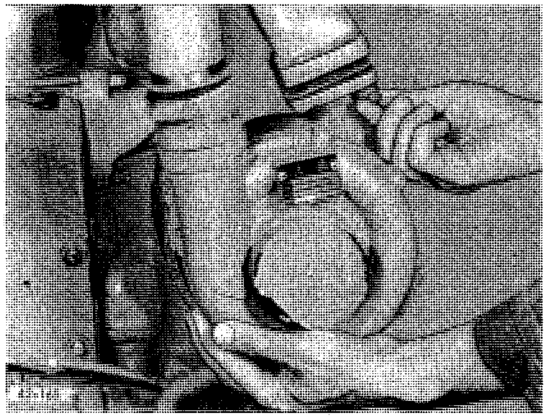


3-57

54. Mount exhaust manifold.
Fig. 3-58

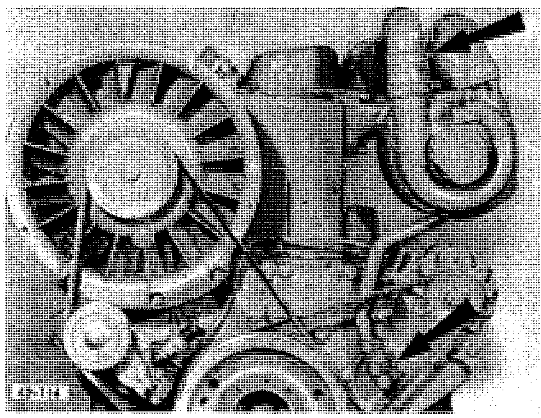


3-58



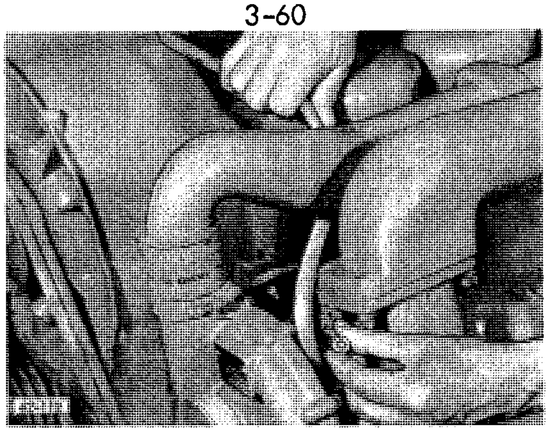
3-59

55. Mount turbocharger c/w gasket.
Fig. 3-59



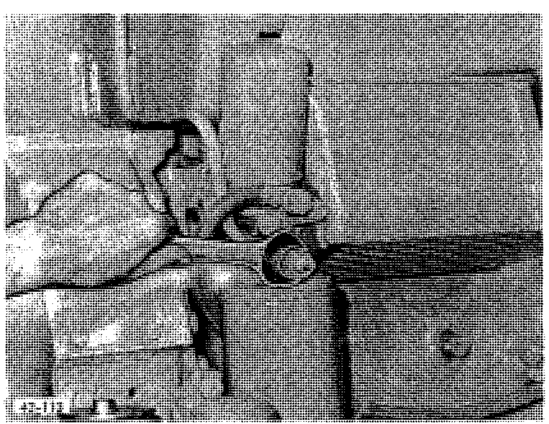
3-60

56. Fasten hose clips.
Fig. 3-60



3-61

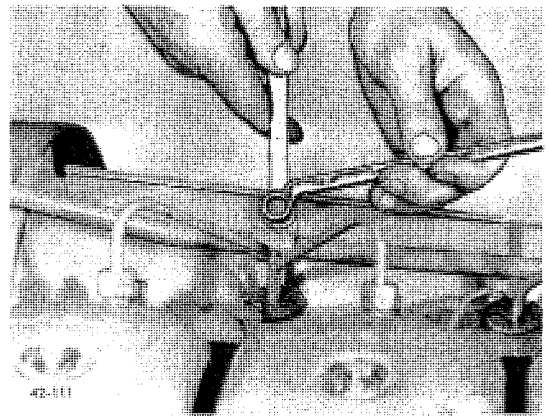
57. Mount lube oil line with gasket at turbocharger. -
Fig. 3-61



3-62

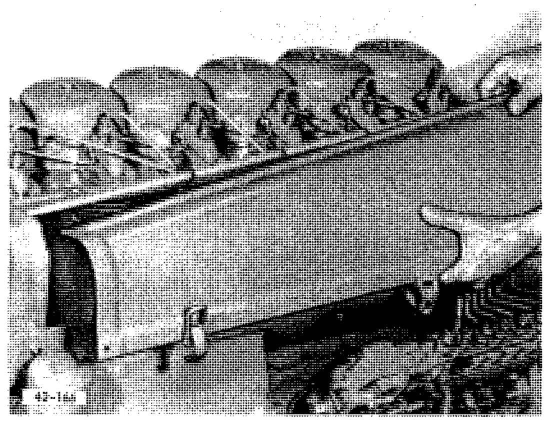
- and with new sealing rings at filter bracket.
Fig. 3-62

58. Mount pipe clips for lube oil line leading to turbocharger.
Fig. 3-63



3-63

59. Mount air cowling.
Fig. 3-64



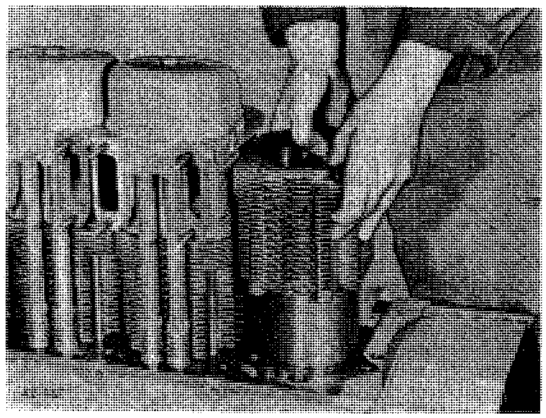
3-64

REMOVING AND REFITTING CYLINDER

Cylinder head and relevant air cowling baffles are removed.

Special tools required:

Piston ring
clamp Ø 100 mm ..... No. 130530
Piston ring
clamp Ø 102 mm ..... No. 130600

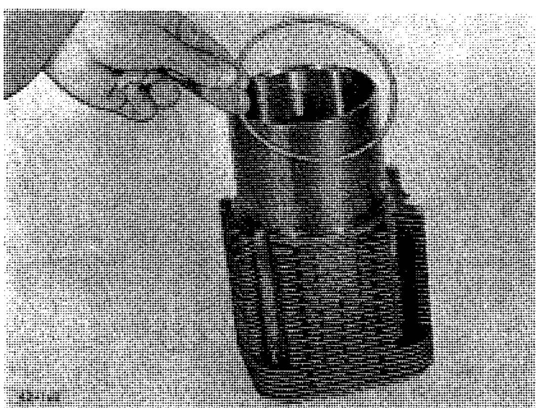


3-65

1. Remove cylinder.

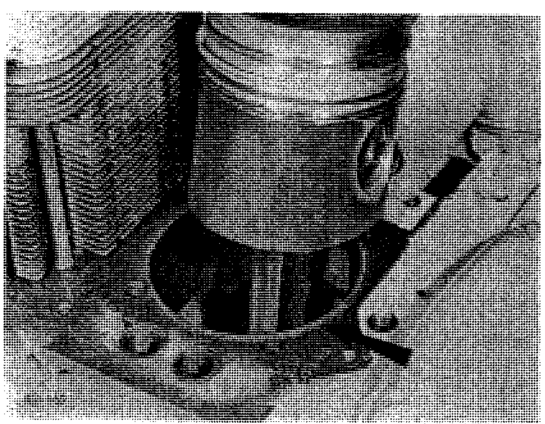
Note:

Be sure the piston will not tilt over so as to get damaged.
Fig. 3-65



3-66

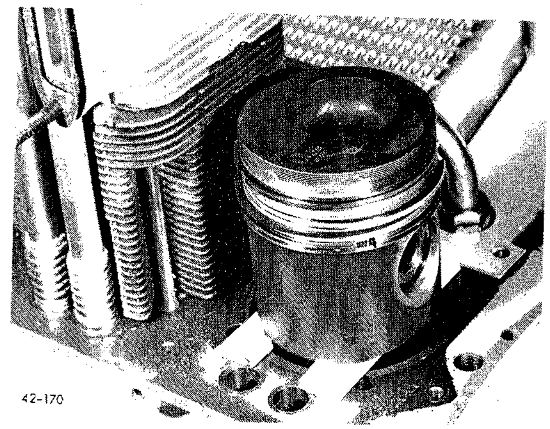
2. Remove shims from cylinder.
Fig. 3-66



3-67

3. Check that cylinder seat on crankcase is smooth and flat. Recondition seat if damaged (see Chapter 4).
Fig. 3-67

4. Place piston on wooden blocks and apply oil.
Fig. 3-68

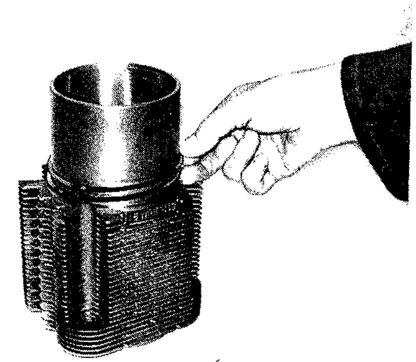

42-170

3-68

5. Affix shims with a little grease.

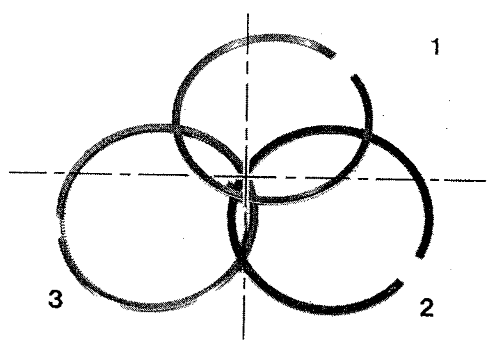
Note:

If reconditioning of cylinder seat was necessary, remeasure piston crown clearance.
Fig. 3-69


42-171

3-69

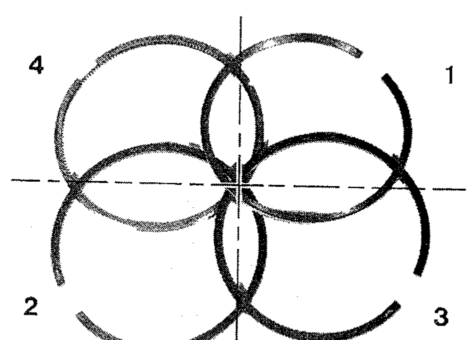
6. Place piston rings so that gaps are offset.
Three-ring piston:
Fig. 3-70



42-172

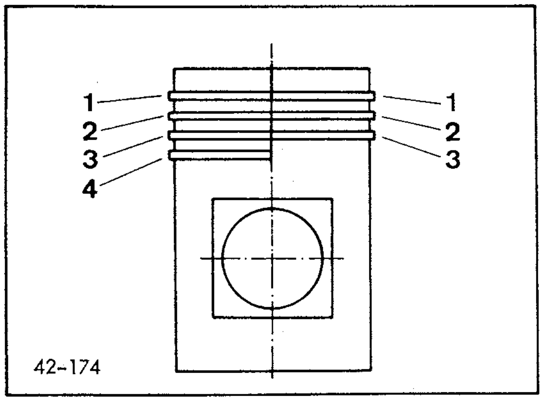
3-70

Four-ring piston:
Fig. 3-71



42-173

3-71



3-72

Note:

Sequence and location of piston rings of three-ring piston:

1) Keystone ring ("TOP" facing top!)
2) Tapered compression ring ("TOP" facing top!)
3) Bevelled-edge slotted oil control ring

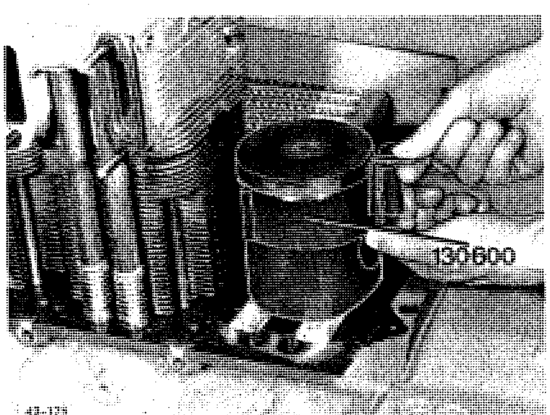
BFL 913

1) Keystone ring ("TOP" facing top!)
2) Keystone ring ("TOP" facing top!)
3) Bevelled-edge slotted oil control ring

Four-ring piston:

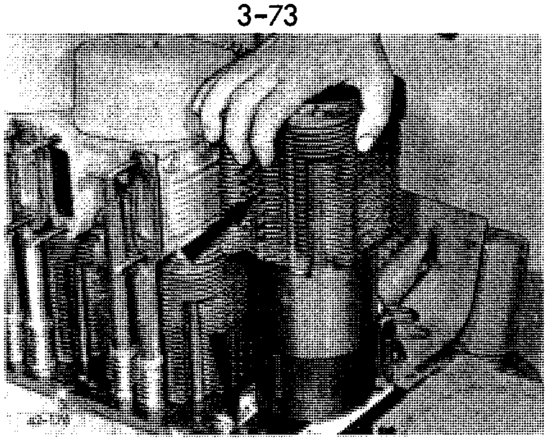
1) Keystone ring ("TOP" facing top!)
2) Tapered compression ring ("TOP" facing top!)
3) Tapered compression ring ("TOP" facing top!)
4) Bevelled-edge slotted oil control ring

Fig. 3-72



3-73

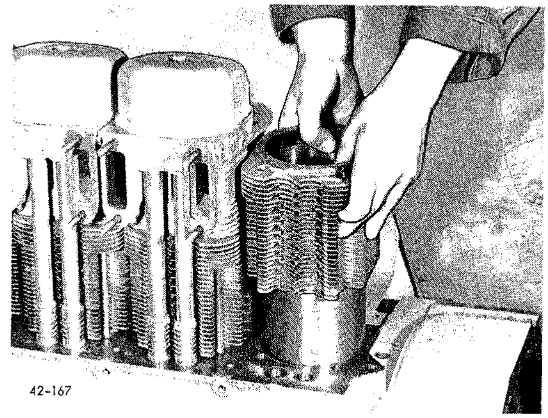
7. Compress piston rings.
Fig. 3-73



3-74

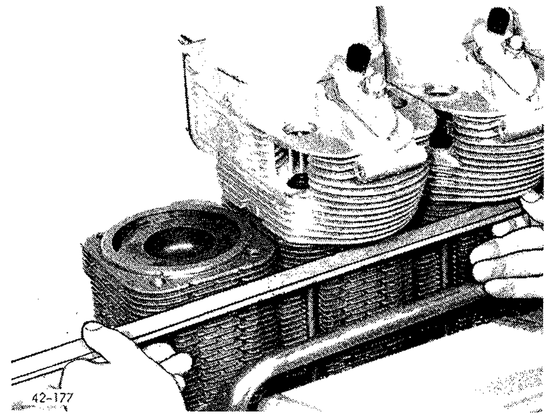
8. Push on cylinder so that the recesses are in line with the tappet bores.
Fig. 3-74

9. Remove piston ring clamp and wooden blocks; push cylinder onto seat.
Fig. 3-75



3-75

10. Bring cylinder into line with adjacent cylinders.
Fig. 3-76



3-76

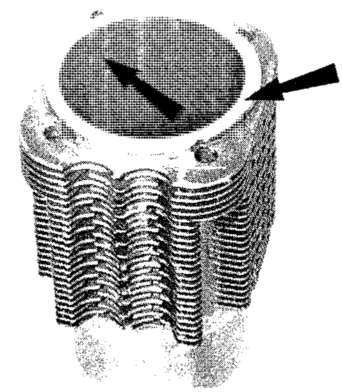
CHECKING CYLINDER

The cylinder is removed.

1. Check cylinder for damage at piston ring travel surface and at sealing surface.

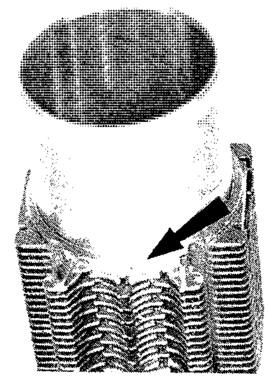
Note:

BFL 913 engines have "hone-lapped" clyinders. These cylinders, specially treated at the working surface, cannot be rehoned. The working surface has hardly visible honing marks, is black in colour, and hardened.
Fig. 3-77

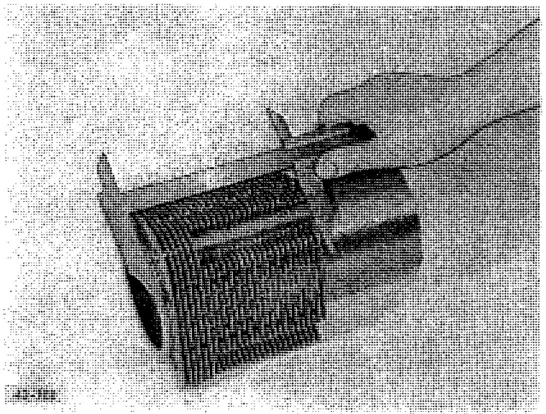


3-77

2. Check cylinder at seating surface.
Fig. 3-78



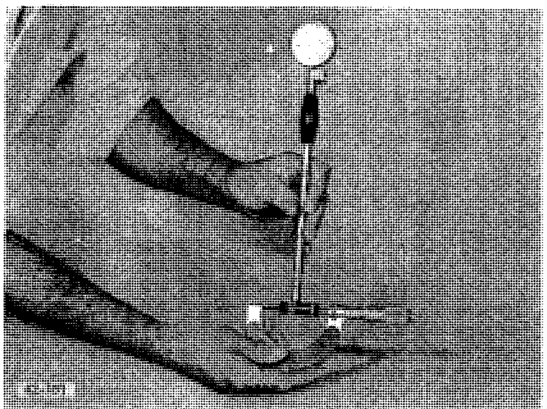
3-78



3-79

305

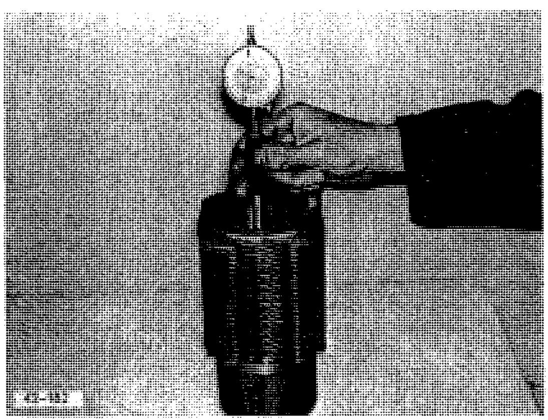
3. Measure height of cylinder.
See Technical Circular.
Fig. 3-79



3-80

301

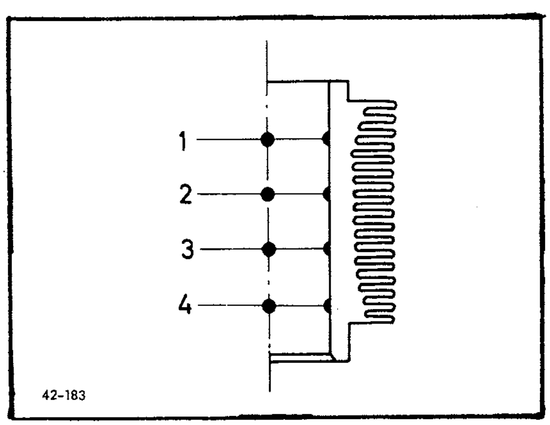
4. Set precision gauge.
Fig. 3-80



3-81

302

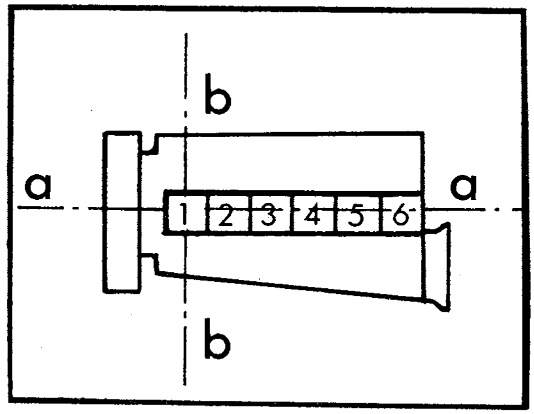
5. Check cylinder, -
Fig. 3-81



3-82

- at levels 1 - 4 -
Fig. 3-82

- of engine centre-line "a" as well as cross-line "b".
Fig. 3-83



3-83

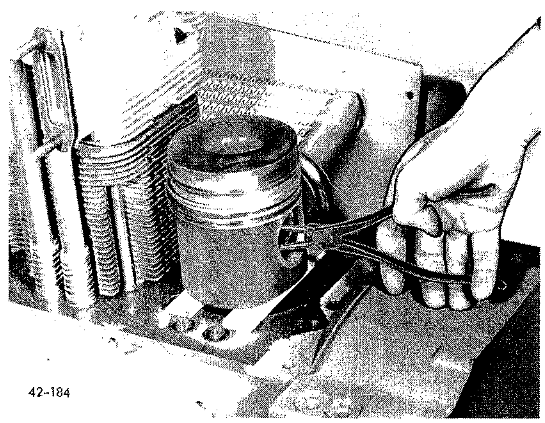
REMOVING AND REFITTING PISTON

Cylinder is removed.

Special tool required:

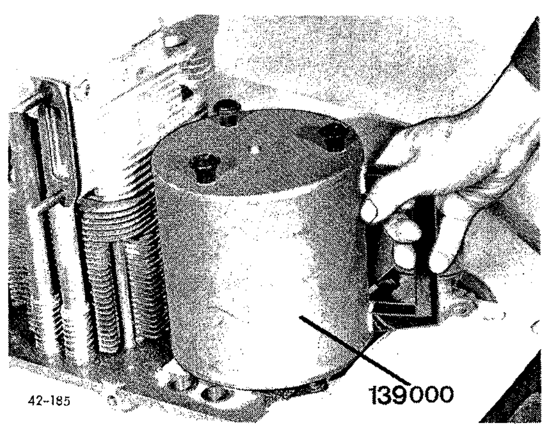
Piston heater .... No. 139000

1. Support piston on wooden blocks and remove circlip.
Fig. 3-84

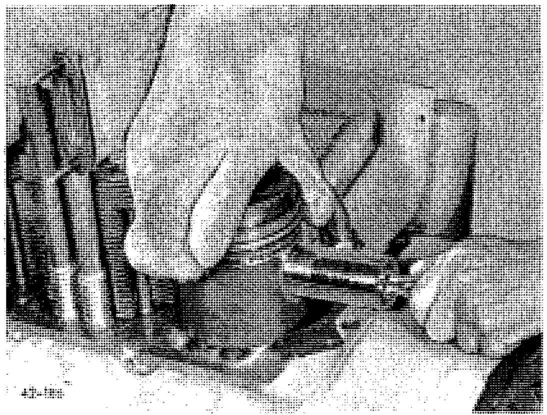


3-84

2. Heat piston to about 80° C.
Fig. 3-85

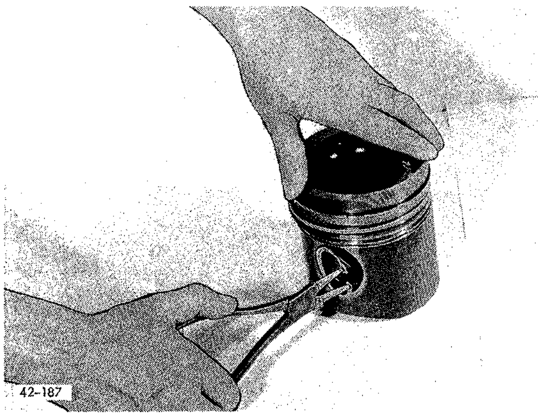


3-85



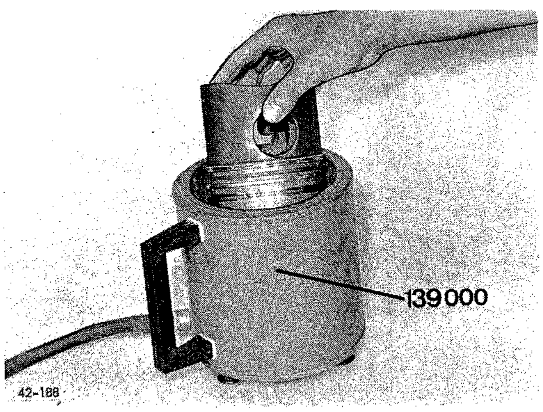
3-86

3. Remove piston pin.
Fig. 3-86



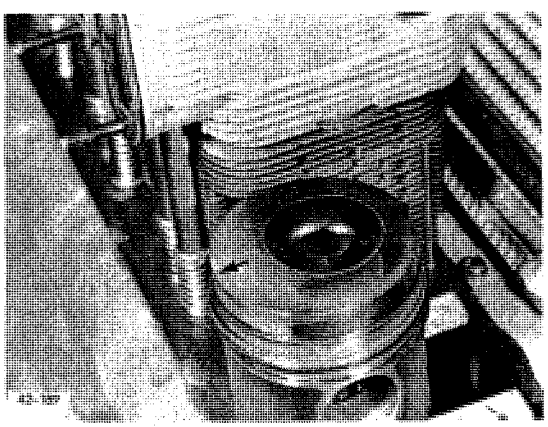
3-87

4. Insert one circlip in piston.
Fig. 3-87



3-88

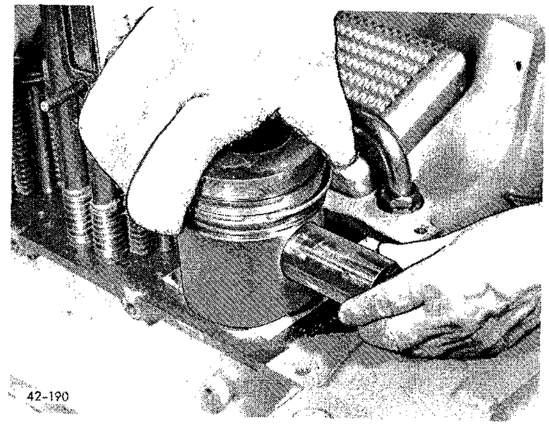
5. Heat piston in heater to about 80° C.
Fig. 3-88



3-89

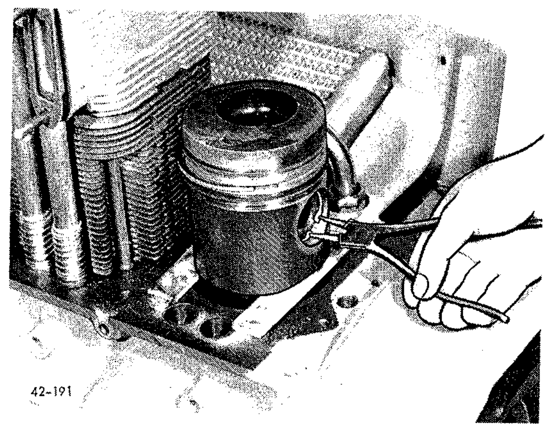
6. The arrow on the piston crown must point to the air discharge side.
Fig. 3-89

7. Oil piston pin bush and piston pin, then connect piston with connecting rod via piston pin.
Fig. 3-90



3-90

8. Insert second circlip.
Fig. 3-91



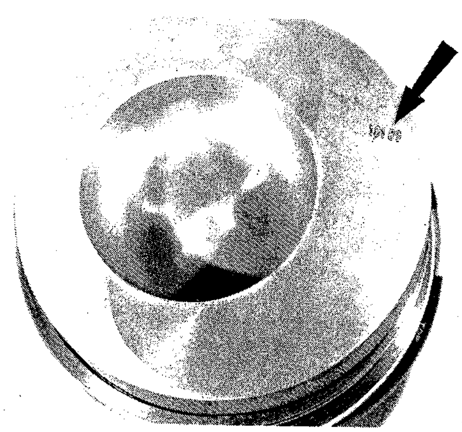
3-91

CHECKING AND MEASURING PISTON

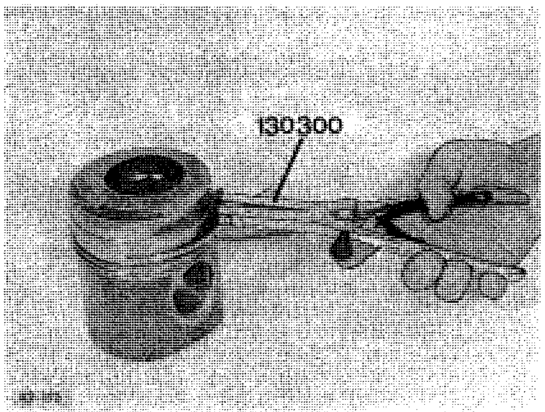
Special tools required:
Universal piston ring pliers .... No. 130300
Keystone-ring groove wear gauge .... No. 130360

401

The diameter is stamped in the piston crown.
Fig. 3-92

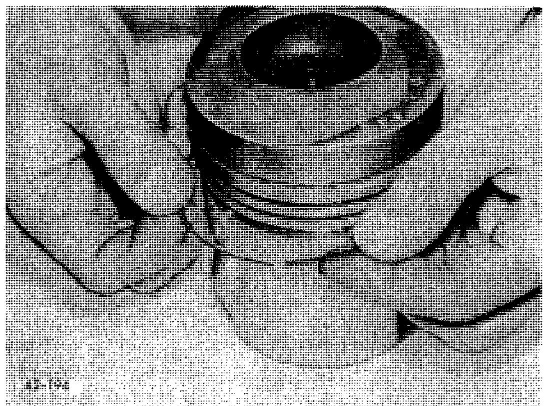


3-92



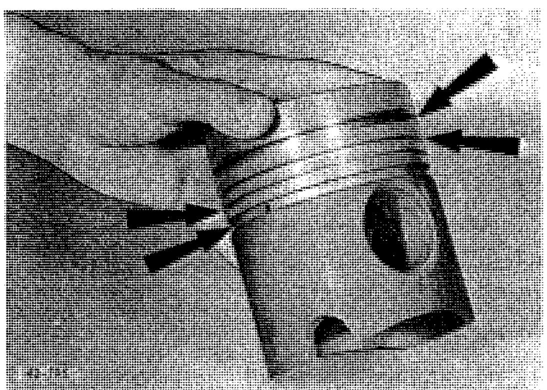
3-93

1. Remove piston rings.
Fig. 3-93



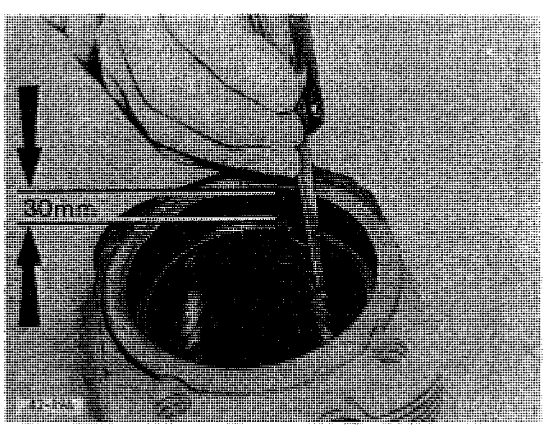
3-94

2. Open and remove hose spring.
Fig. 3-94



3-95

3. Clean piston and ring grooves.
Inspect for damage and wear.
Fig. 3-95

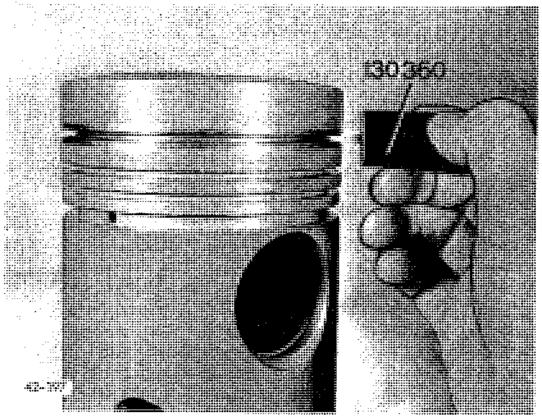


4. Gauge ring gaps.
Fig. 3-96

429 – 436

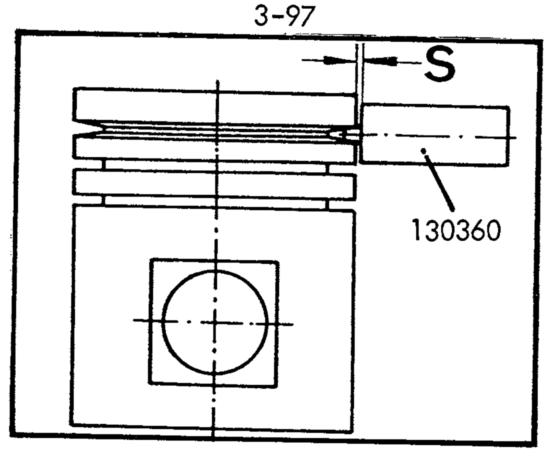
3-96

5. Measure axial clearance. Check keystone-ring groove dimensions with special gauge.
Fig. 3-97



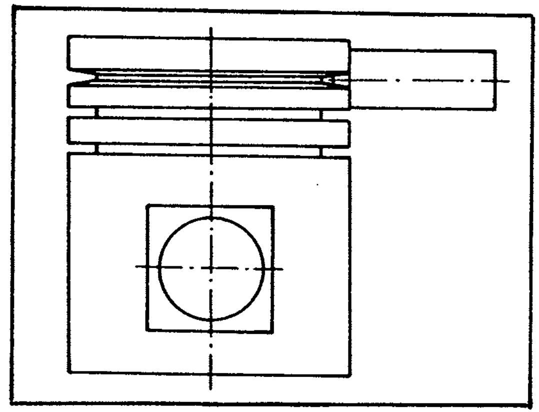
3-97

6. If a gap "S" remains between gauge and piston, the keystone-ring groove is not worn.
Fig. 3-98



3-98

7. If there is no gap between gauge and piston, renew piston.
Fig. 3-99



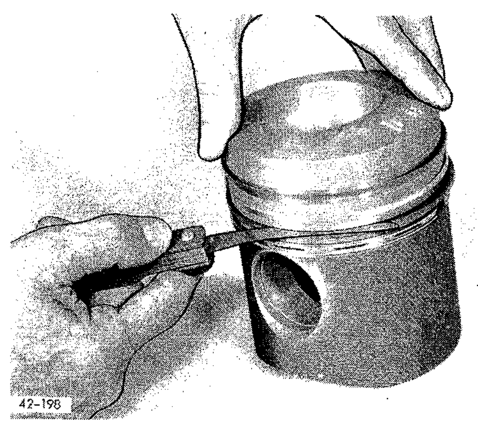
3-99

8. Gauge 2nd, 3rd and, if applicable, 4th ring grooves.

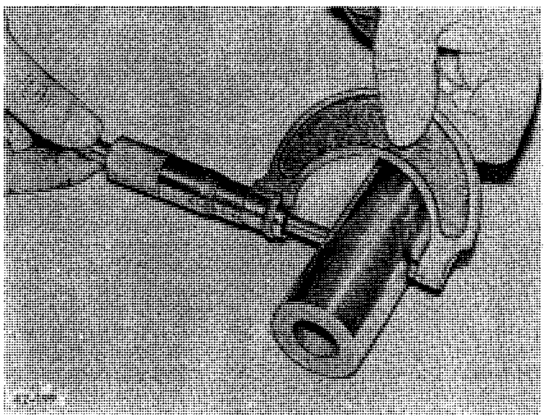
423 – 428

Note:

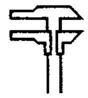
Gauge with new piston rings fitted.
Fig. 3-100

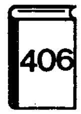


3-100



3-101





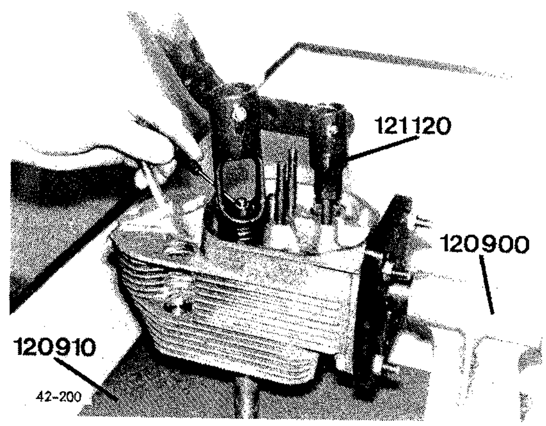
9. Check piston pin for wear.
Fig. 3-101

CHECKING AND REPAIRING CYLINDER HEAD

Special tools required:

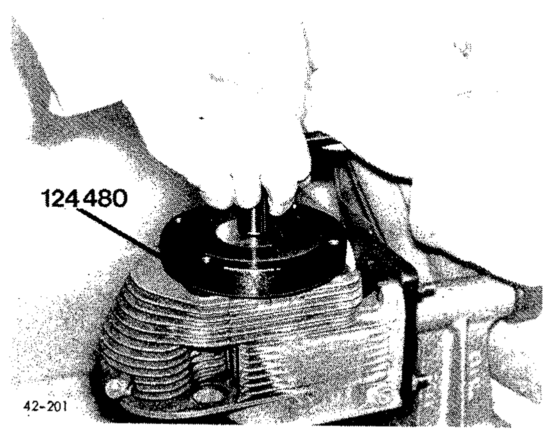
Clamping stand	No. 120900
Clamping plate	No. 120910
Valve spring compressing tool	No. 121120
Valve seat cutter: Inlet/Exhaust 30°/45°	No. 122302
Holder	No. 122304
Guide mandrel	No. 122305
Accessories	No. 122306
Clamping arbor	No. 122450
Drilling jig	No. 122460
Pilot pin with drill sleeves	No. 122461
Hard-metal special cutter	No. 122463
Mandrel	No. 123310
Reamer for valve guides, 8 mm dia......	No. 123510
Mandrel, Exhaust	No. 123950
Inlet	No. 123960
Cutting device	No. 124480
Lathe fixture	No. 125500

1. Clamp cylinder head on stand and dismantle.
Fig. 3-102

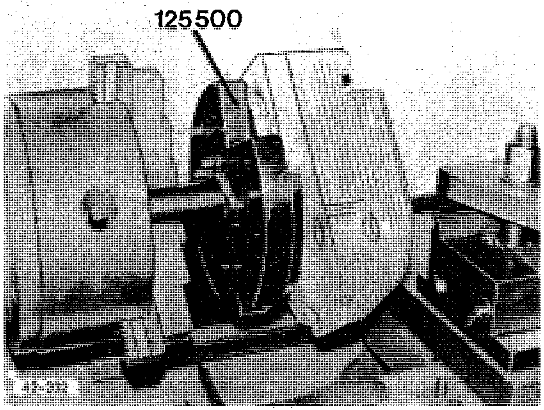


3-102

2. If cylinder head sealing surface is damaged, reface with cutting device.
Fig. 3-103



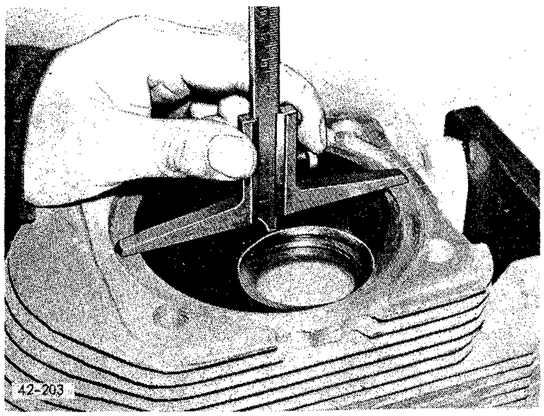
3-103



3-104

Note:

Cylinder heads with sealing ring can be reworked only on a lathe, using the lathe fixture.
Fig. 3-104



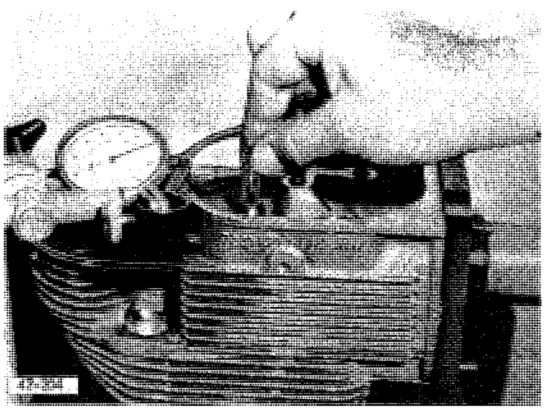
3-105

273

3. After reworking, gauge distance between cylinder head bottom and sealing surface.

Note:

If a sealing ring is present, gauge together with sealing ring.
Fig. 3-105

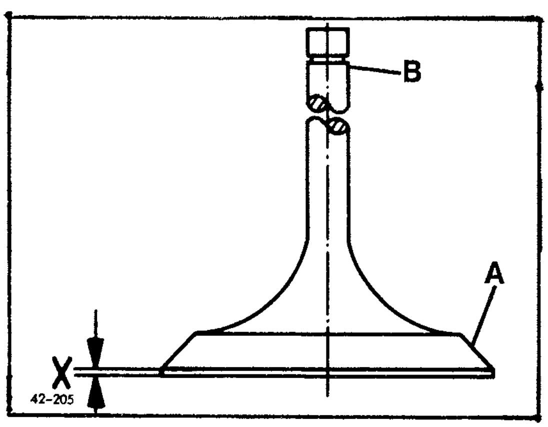


3-106

CHECKING VALVE STEM, VALVE AND VALVE SEAT

233
235

4. Gauge valve stem clearance.
Fig. 3-106



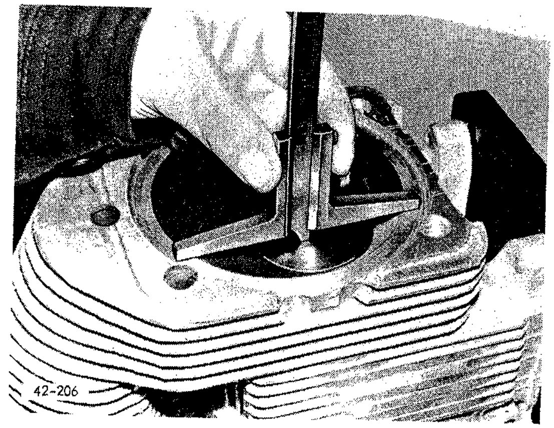
3-107

230

5. Check condition of valve:
A = Valve seat
B = Collet seat
X = Valve edge thickness
Fig. 3-107

6. Insert inspected or new valve. Gauge distance from valve disc centre to sealing surface (valve set-back dimension).
Fig. 3-108

271

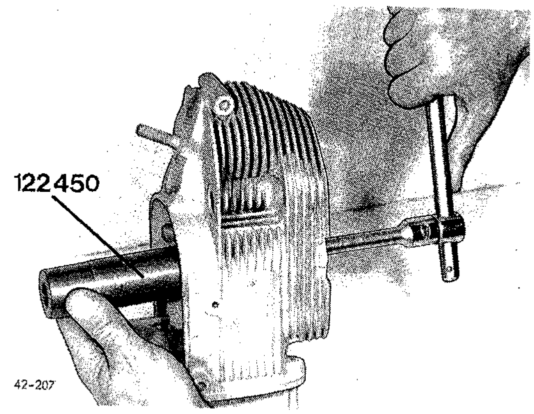


3-108

Removing and installing valve seat rings:

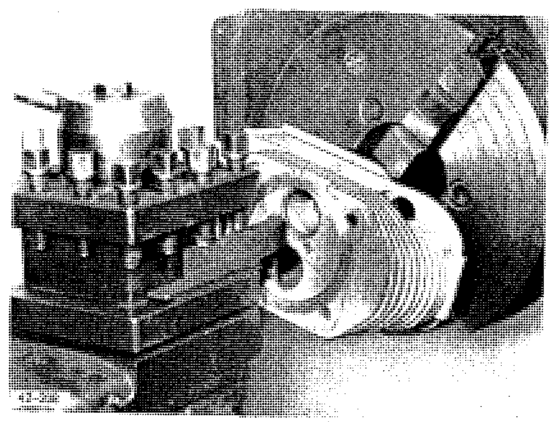
a) With lathe

7. Mount clamping arbor in cylinder head.
Fig. 3-109



3-109

8. Turn out valve seat rings.
Fig. 3-110



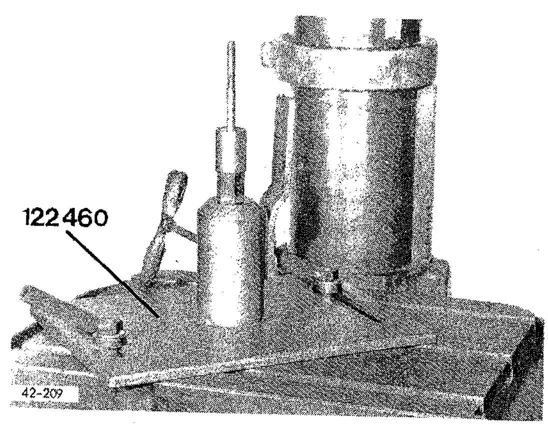
3-110

b) With drilling machine

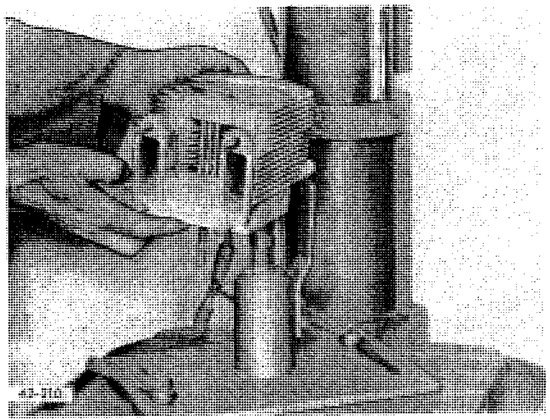
9. Fasten jig onto drilling table.
Do not tighten fastening nuts for the time being.

Note:

The cutting process is to be carried out on a drilling machine having a spindle diameter of at least 50 mm and at a speed of 300-350/min.
Fig. 3-111

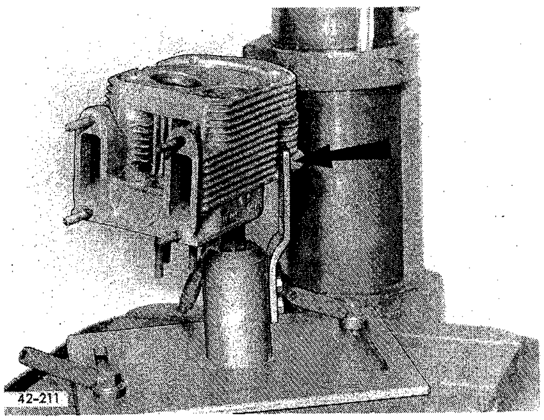


3-111



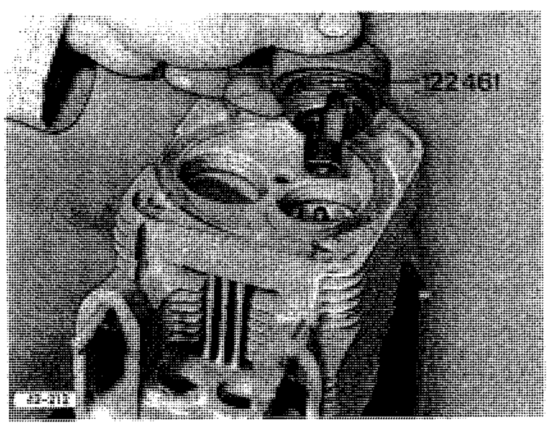
3-112

10. Place cylinder head onto jig via valve guide.
Fig. 3-112



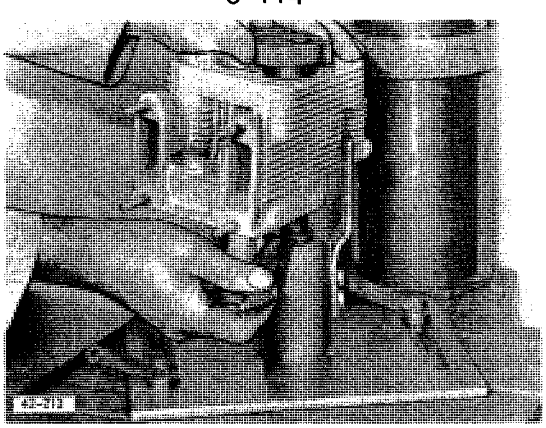
3-113

11. Push down cylinder head as far as it will go.
Fig. 3-113



3-114

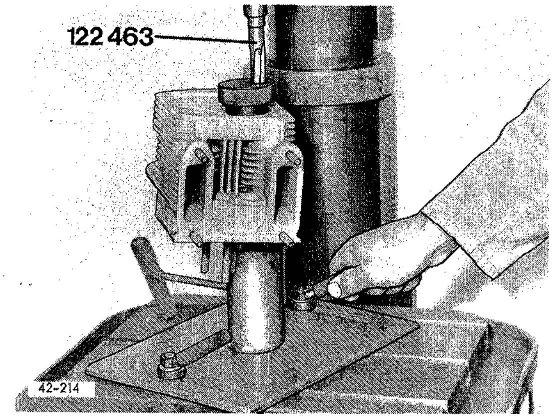
12. Screw on drill sleeve.
Fig. 3-114



3-115

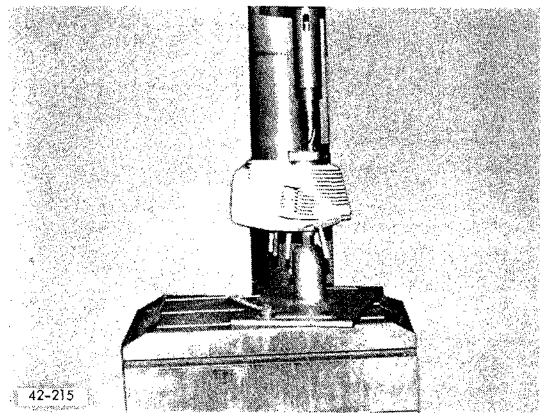
13. Tighten drill sleeve.
Fig. 3-115

14. Guide special cutter into position in drill sleeve by moving drilling jig accordingly, and tighten jig nuts.
Fig. 3-116



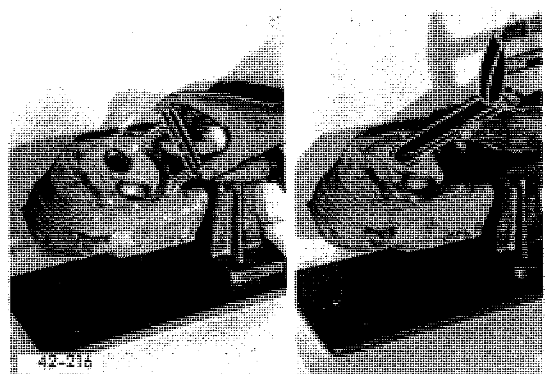
3-116

15. Mill valve seat ring down to base, taking care not to damage ring seat.
Fig. 3-117



3-117

16. Prise out valve seat ring with self-made tool.
Fig. 3-118

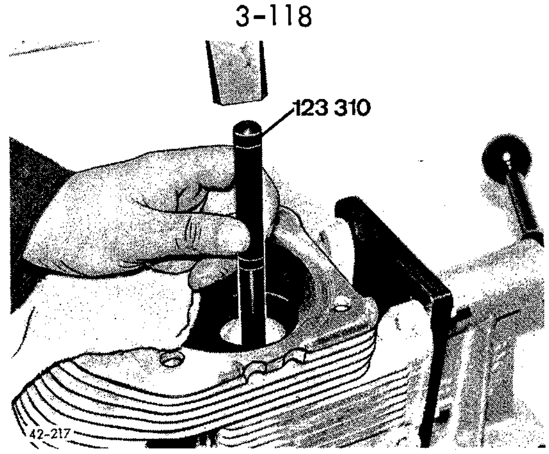


3-118

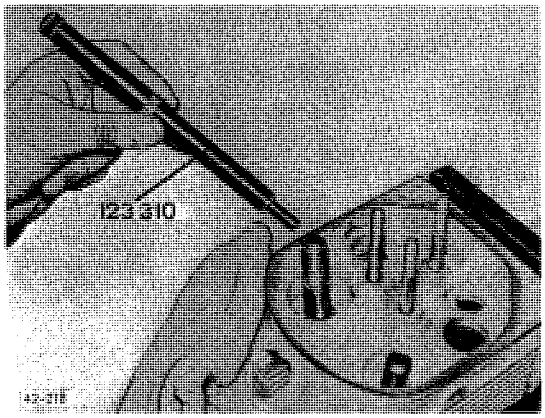
17. Renewing valve guides:
Heat cylinder head in oven to 220° C. Drive out valve guides.

Note:

For renewal of valve seat rings and valve guides, the cylinder head should be heated to 220° C once only.
Fig. 3-119

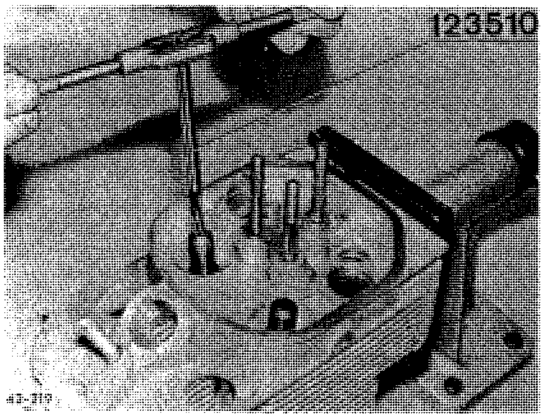


3-119



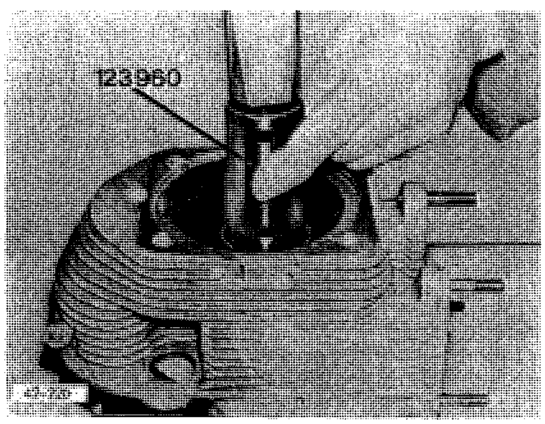
3-120

23. Fit new valve guides.
Fig. 3-120



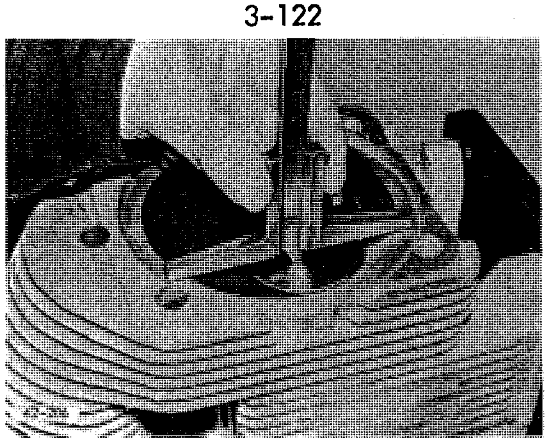
3-121

19. After shrinkage, run reamer down valve guides.
Fig. 3-121



3-122

20. Fit new valve seat rings.
Fig. 3-122

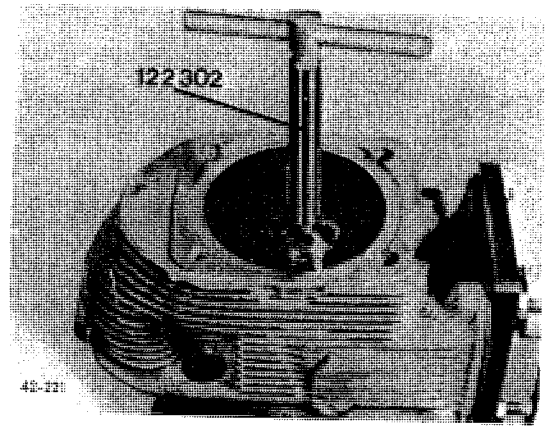


3-123

21. Insert valve. Check distance from valve disc centre to sealing surface (valve set-back dimension).
Fig. 3-123

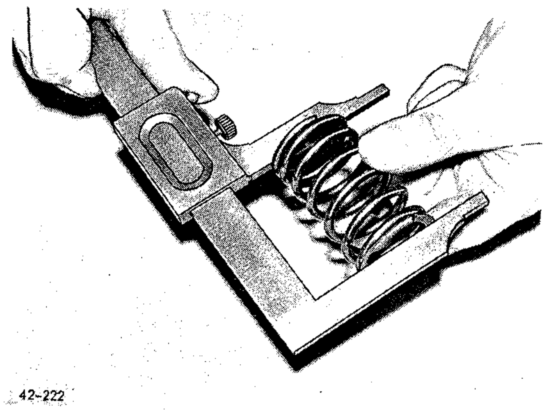
271

22. Correct as necessary with special seat cutter.
Fig. 3-124



3-124

23. Gauge length of valve springs.
Fig. 3-125

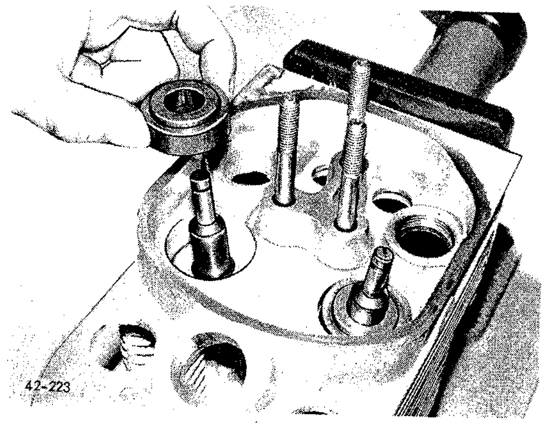


3-125

24. Check valve rotator for easy movement. Inset valves and valve rotator.

Note:

Engines without valve rotator have a spring retainer under the valve spring.
Fig. 3-126

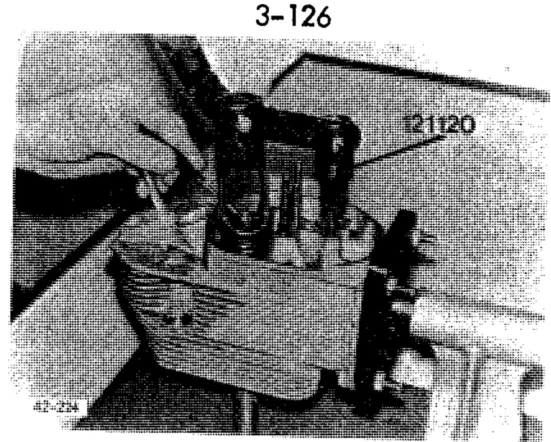


3-126

25. Place on valve springs with the closer windings towards the rotator, then complete assembly of the valves, using valve spring compressing tool.

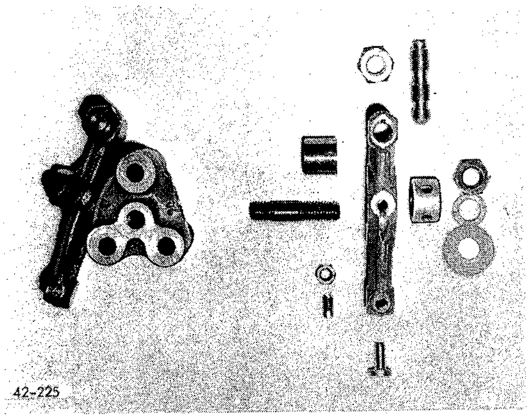
Note:

Check old valve collets for wear, renewing if necessary. After assembling, check for proper seating.
Fig. 3-127



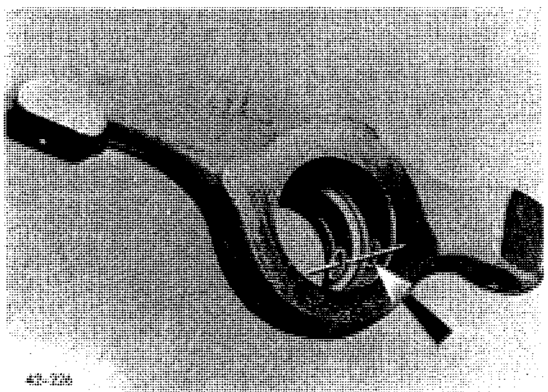
3-127

RECONDITIONING ROCKER ARM BRACKET



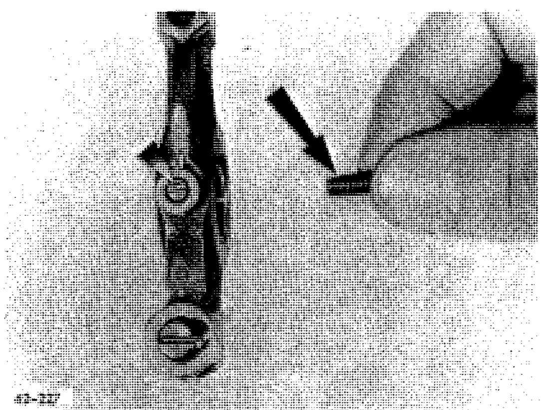
3-128

26. Dismantle rocker arm bracket and check for wear.
Fig. 3-128



3-129

27. When renewing the bearing bush, make sure that the oil holes coincide.
Fig. 3-129



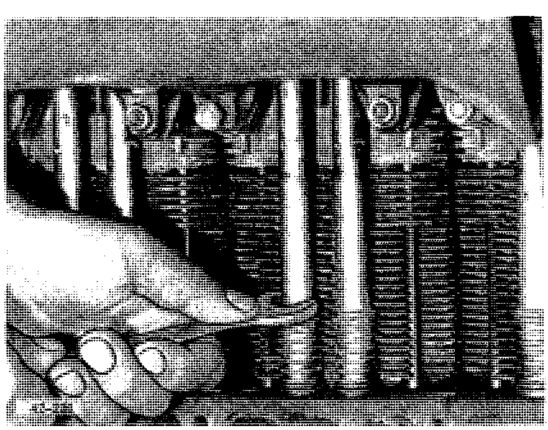
3-130

28. Insert oil metering screw. One thread should project beyond the lock nut, and the chamfer should face the thrust pad.

Note:

Finely adjust at low idling so that a small oil flow toward the thrust pad is just visible.
Fig. 3-130

SEALING PUSHROD COVER TUBES



3-131

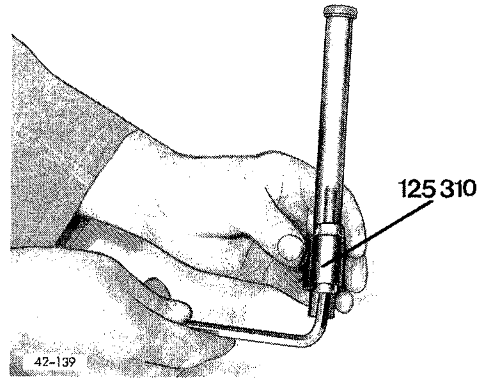
Rocker arm bracket, pushrods and accessories are already removed.

Special tool required:

Spring compressing tool .... No. 125310

1. Press down spring, release cover tube and remove.
Fig. 3-131

2. Push spring onto pushrod cover tube and compress spring.
Fig. 3-132

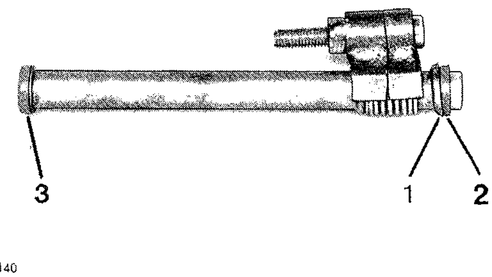


3-132

3. Complete assembly of pushrod cover tube.

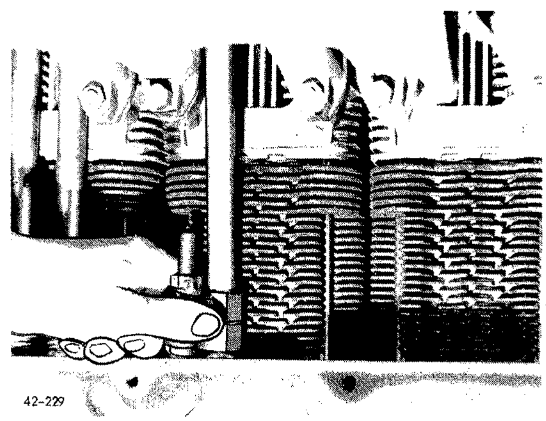
SEQUENCE OF ASSEMBLY

1. Profile washer
2. Lower profile seal
3. Upper profile seal
Fig. 3-133



3-133

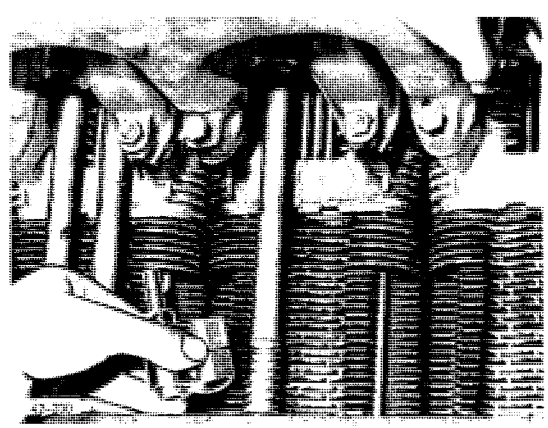
4. Introduce pushrod cover tube first into crankcase. -
Fig. 3-134



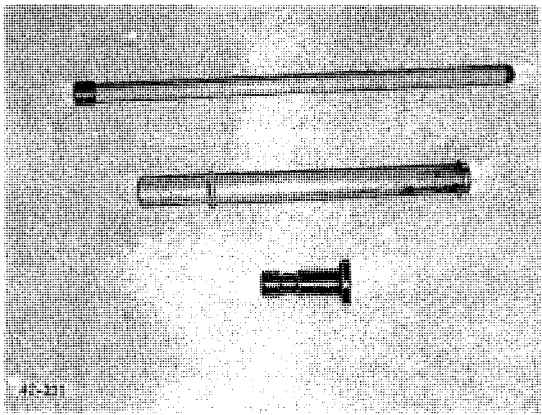
3-134

- and then into the cylinder head. Remove spring compressing tool.
Fig. 3-135

5. Complete assembly of engine.



3-135



3-136

CHECKING PUSHRODS, PUSHROD COVER TUBES AND TAPPETS

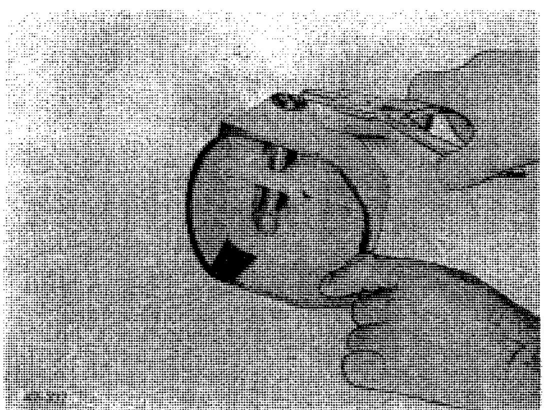
- Check that rod ends are firmly seated and free from wear.

- Check that rods are straight and that oil bores are free.

- Check that cover tubes are straight and free from defects.

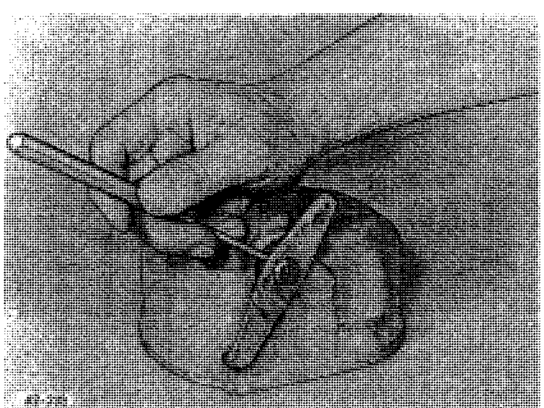
- Check that tappets are not worn and that oil bores are free.
Fig. 3-136

DISMANTLING AND REASSEMBLING DECOMPRESSION DEVICE



3-137

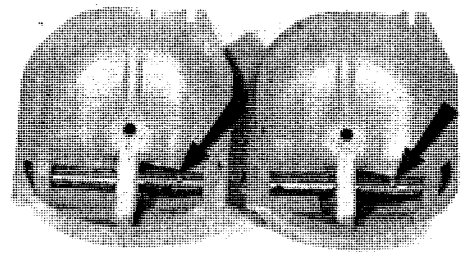
1. Remove one circlip from rocker cover of cyl. 1. Drive grooved pin and grooved rivet out of shaft. Withdraw shaft.
Fig. 3-137



3-138

2. Drive grooved pin out of control lever at rocker cover of cyl. 2 and grooved rivet out of shaft. Withdraw shaft.
Fig. 3-138

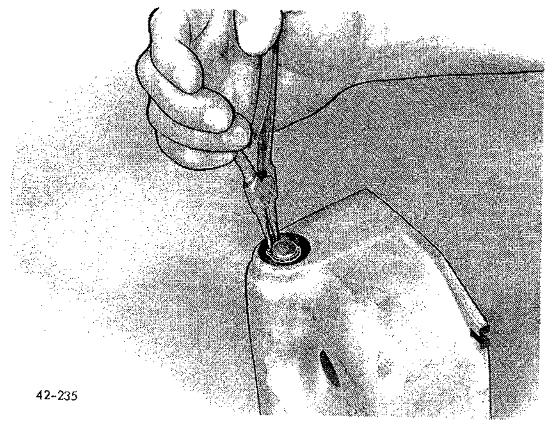
3. Place springs in position, introduce shafts c/w O-seals, then drive grooved rivets through sprig hooks into the shafts (see arrows).
Fig. 3-139



42-234

3-139

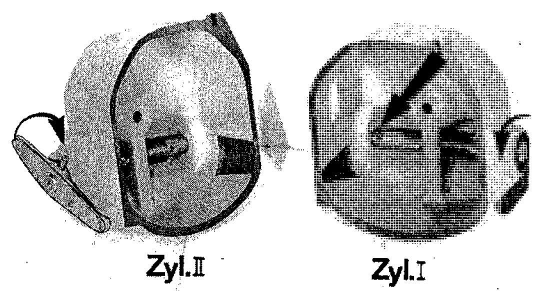
4. Insert circlip at rocker cover of cyl. I.
Fig. 3-140



42-235

3-140

5. Pretension springs by turning shaft I 3/4 turns in direction of arrow.
Cyl. 2: Mount lever
Cyl. I: Drive in grooved pin
Fig. 3-141



42-236

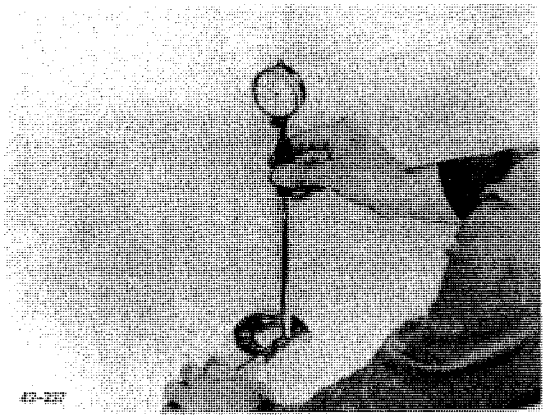
3-141

CHECKING CONNECTING RODS

GAUGING, RENEWING SMALL-END BUSH

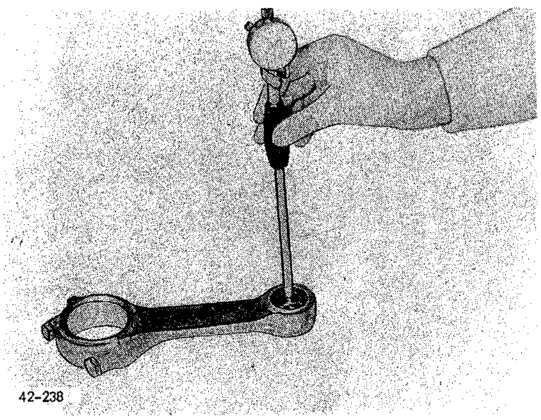
Special tools required:

Device .... No. 131310
Device (BFL 913) ..... No. 131320



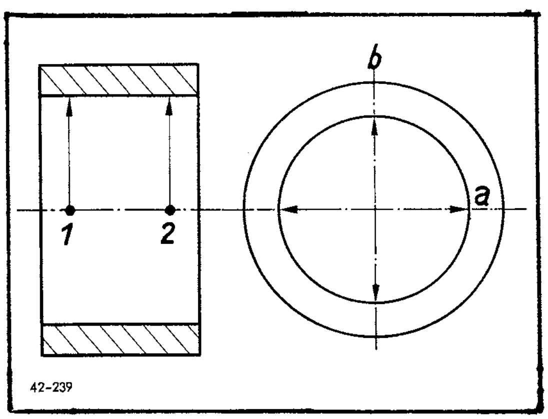
3-142

1. Set internal-measuring instrument.
Fig. 3-142



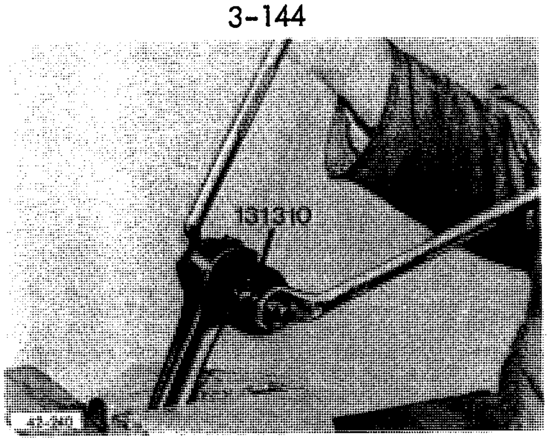
3-143

2. Gauge small-end bush -
Fig. 3-143



3-144

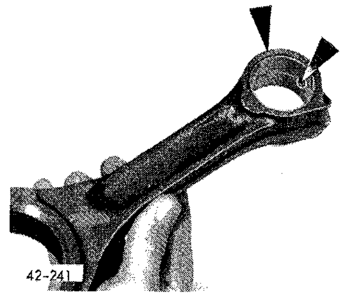
- at points 1 and 2 in planes "a" and "b".
Fig. 3-144



3-145

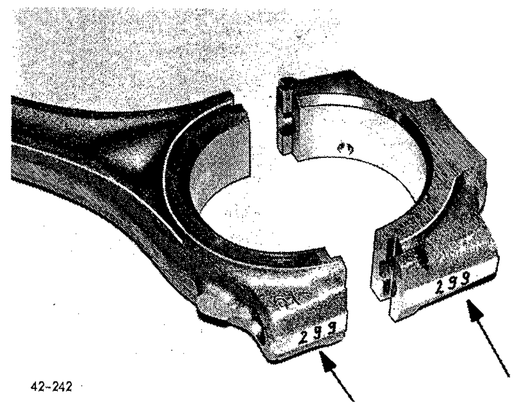
3. If necessary, renew bush.
Fig. 3-145

4. Oil holes in bush and connecting rod must coincide after pressing in bush.
Fig. 3-146



3-146

5. Make sure that rod and cap have the same identification number.
Fig. 3-147

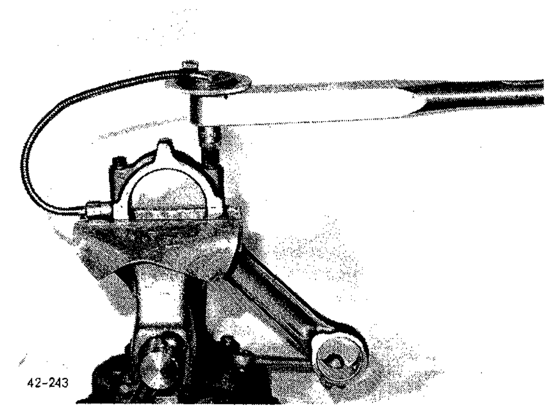


3-147

6. Mount bearing cap. Tighten bolts as specified.

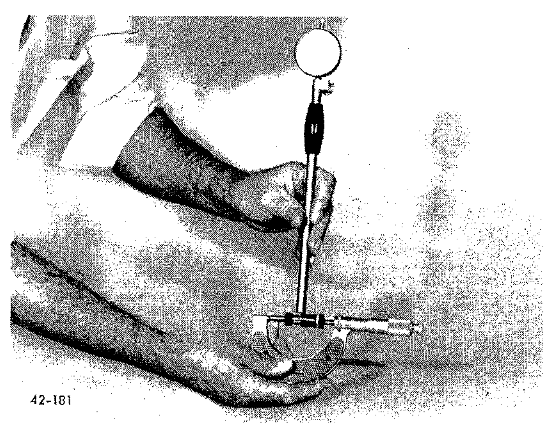
Note:

Do not clamp rod in vice at the shank.
Fig. 3-148

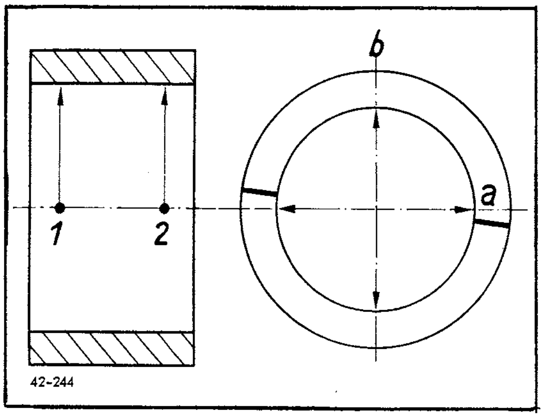


3-148

7. Set internal-measuring instrument to bore for big-end bearing.
Fig. 3-149

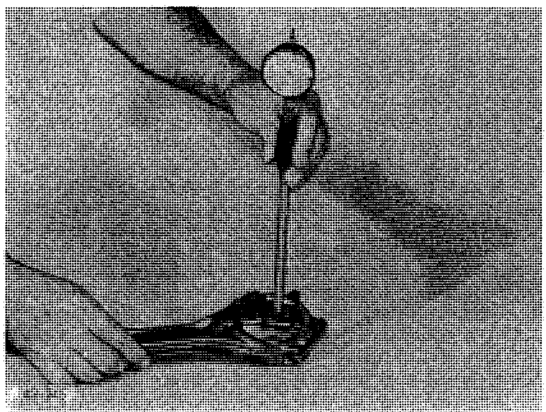


3-149



3-150

8. Gauge big-end bore at points 1 and 2 in planes "a" and "b".
Fig. 3-150

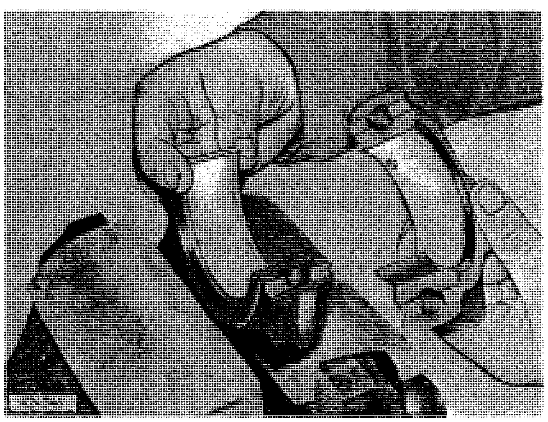


3-151

9. If gauge readings conform to the specified values, the necessary preload will be obtained after installation of the bearing shells.

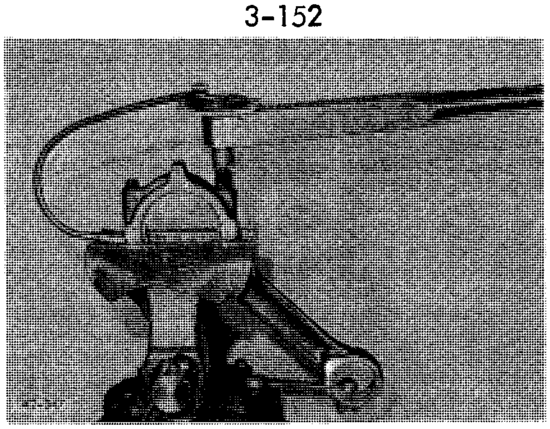
Note:

If the measured values deviate only slightly, the following measurements are to be carried out.
Fig. 3-151



3-152

10. Insert new bearing shells.
Fig. 3-152



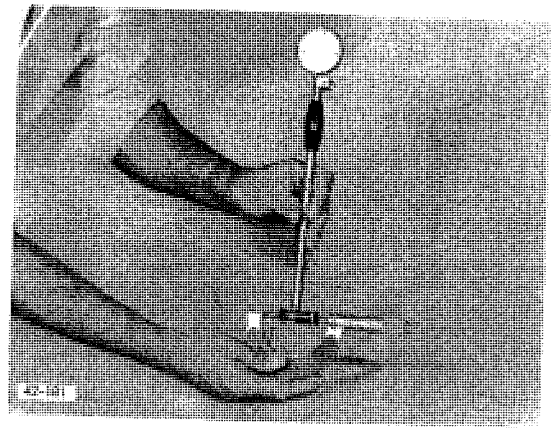
11. Refit bearing cap. Tighten bolts as specified.
Fig. 3-153

903

3-153

12. Set internal-measuring instrument to inside diameter of big-end bearing shells.
Fig. 3-154

608

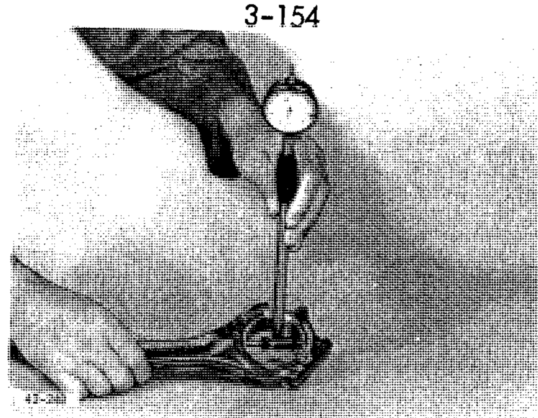


3-154

13. Gauge big-end bearing.

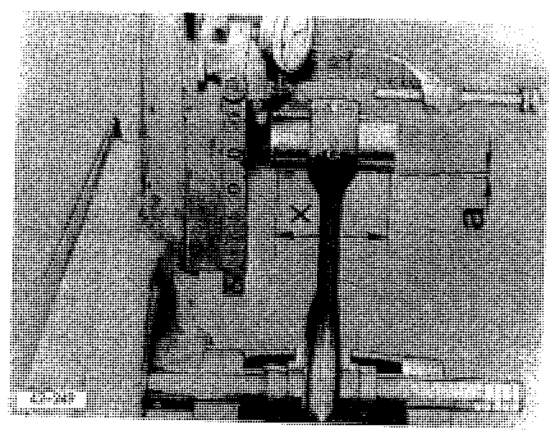
Note:

If the readings deviate by not more than 0.020 mm beyond the bearing tolerances, the rod can be reused. In the case of greater deviation, the rod must be renewed.
Fig. 3-155



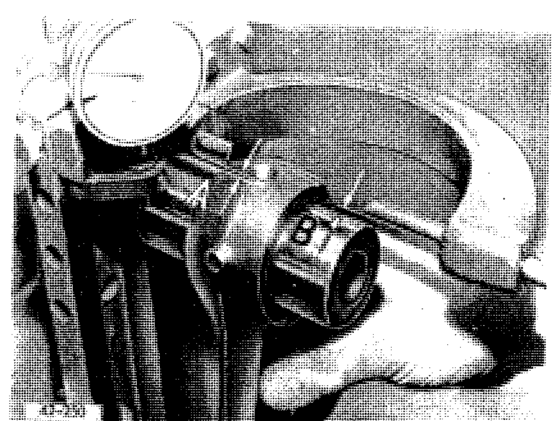
3-155

14. Check connecting rod without bearing shells on a connecting rod tester for parallelism. The deviation may not exceed a = 0.15 mm over a distance of x = 100 mm.
Fig. 3-156

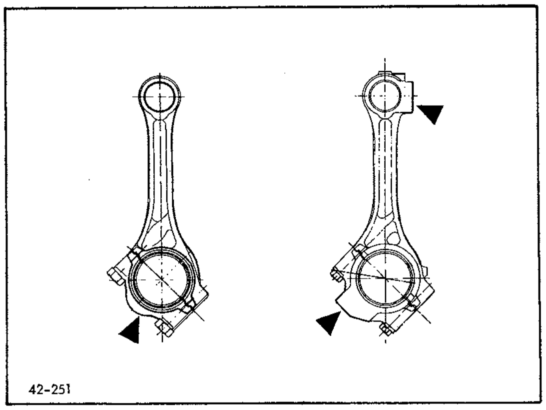


3-156

15. Check connecting rod for squareness. The deviation between "A" and "B" may not exceed 0.05 mm.
Fig. 3-157



3-157



3-158

Note:

- The installation of mixed connecting rods with and without balancing weights in an engine is not permissible.
Fig. 3-158

- Four-cylinder tractor engines with mass balancing gear (MAG): Renew connecting rods in same weight class and in pairs only, i.e. cyls. Nos. 1 and 4 together, or cyls. Nos. 2 and 3 together.

Index

4. Crankshaft, Camshaft, Crankcase

Page

CHECKING CRANKCASE

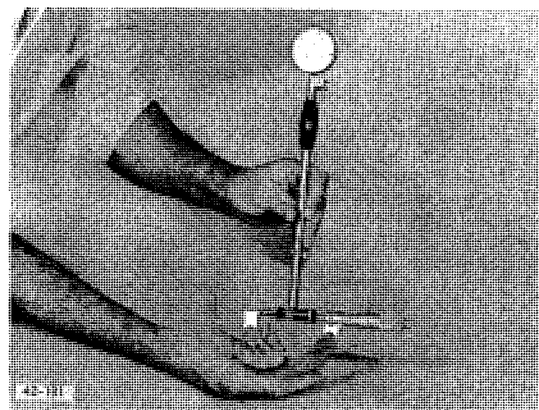
Special tools required:

Press-in device ...... No. 143610
Refacing device ...... No. 150020

1. Clean crankcase. Check oilways for free passage. Inspect crankcase walls and bearing webs for cracks.

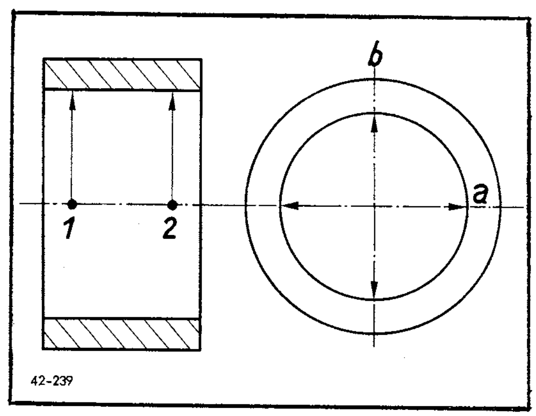
Gauge bores for camshaft and crankshaft bearings.

2. Set internal-measuring instrument.
Fig. 4-1



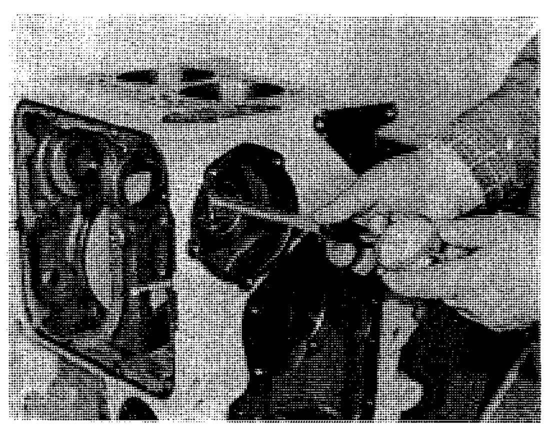
4-1

3. At points 1 and 2 in planes "a" and "b",...
Fig. 4-2

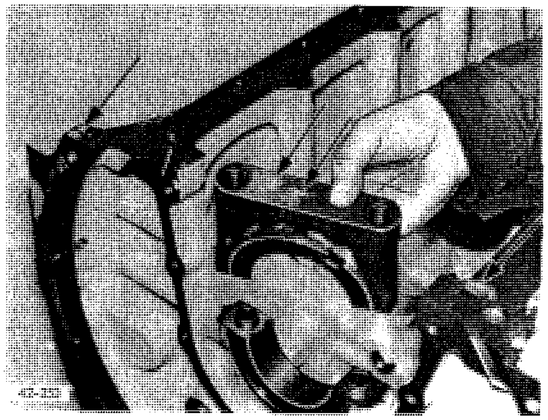


4-2

...gauge camshaft bearing bores.
Fig 4-3

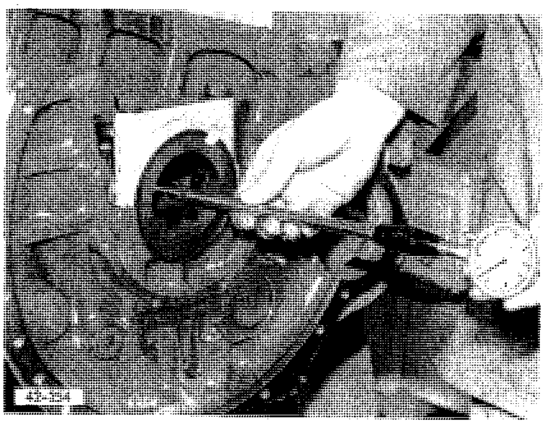


4-3



4-4

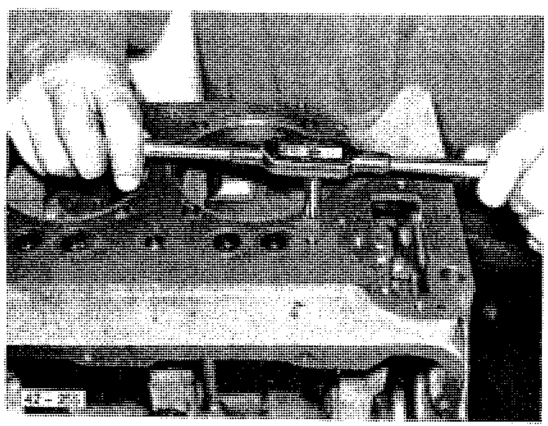
4. Mount bearing cap at appropriate position on crankcase according to mating marks.
Fig. 4-4



4-5

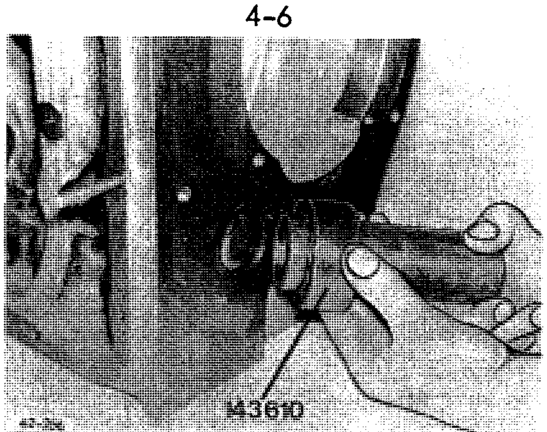
904
561

5. Tighten main bearing bolts as specified and gauge crankshaft bearing bores.
Fig. 4-5



4-6

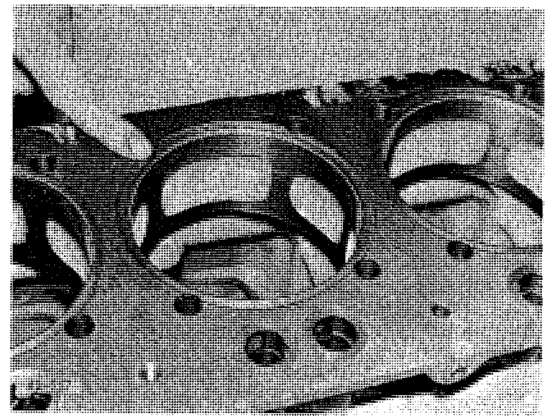
6. Run tap down threaded bores for cylinder head bolts.
Fig. 4-6



4-7

7. Renew leaky or loose plug. Apply sealing compound to new plug and drive in with special tool.
Fig. 4-7

8. Check cylinder seating surfaces for damage.
Fig. 4-8



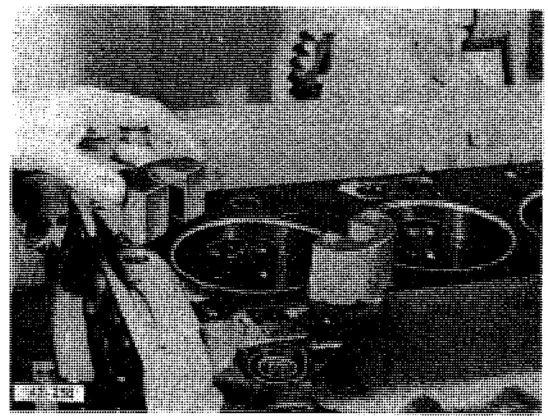
4-8

RECONDITIONING CYLINDER SEATING ON CRANKCASE

Special tool required:

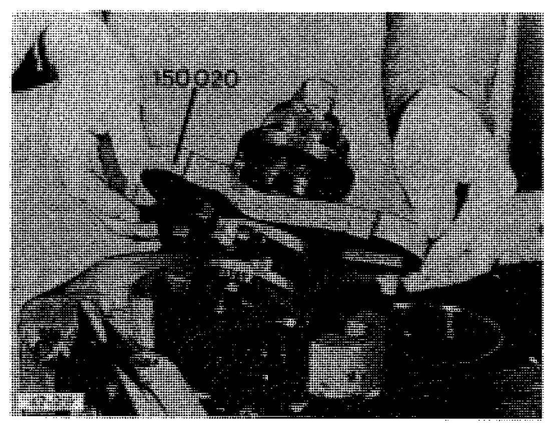
Refacing device ...... No. 150020

1. Clean seating surface. Place supporting blocks in position.
Fig. 4-9



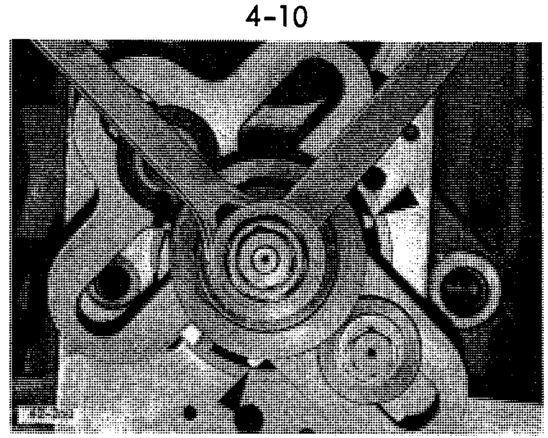
4-9

2. Mount refacing device. Screw in fastening bolts and tighten slightly, so that the device is still movable.
Fig. 4-10

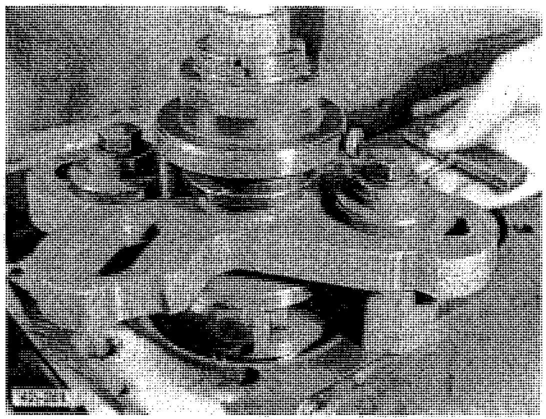


4-10

3. Locate device by means of the centering fingers, then fully tighten the fastening bolts.
Fig. 4-11

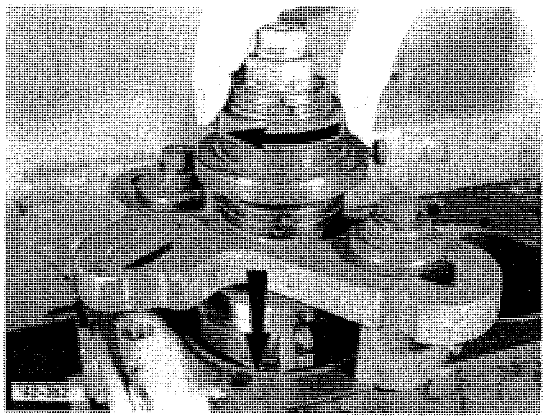


4-11



4-12

4. Withdraw centering fingers and extend tool holder to rest somewhat above the beginning of the inside diameter of the seating to be refaced.
Fig. 4-12

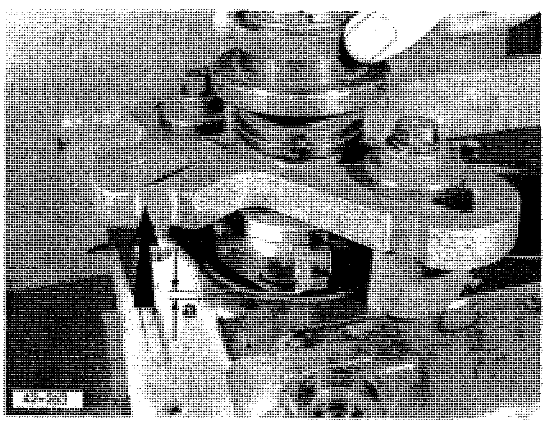


4-13

5. Turn knurled nut to lower tool holder so that the cutter lightly contacts the seating to be refaced.

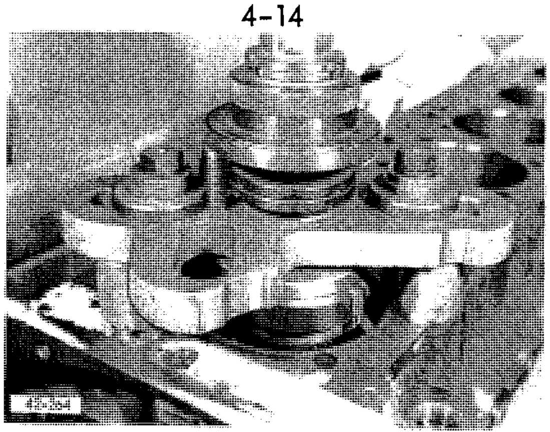
Note:

Adjust cutter feed carefully. One complete turn (360°) of the knurled nut represents a cutter feed of 1.5 mm.
Fig. 4-13



4-14

6. Turn back knurled nut until tool is again positioned freely above the surface to be reworked. Distance "a".
Fig. 4-14



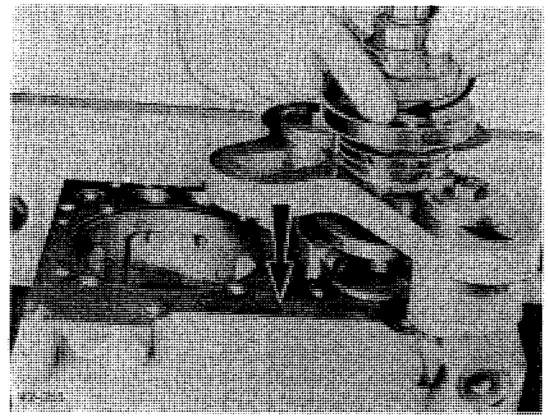
4-15

7. Withdraw tool holder towards the middle of the cylinder receiving bore.
Fig. 4-15

8. Turn knurled nut to bring tool holder slightly beyond the retracted distance "a" obtained under point 6.

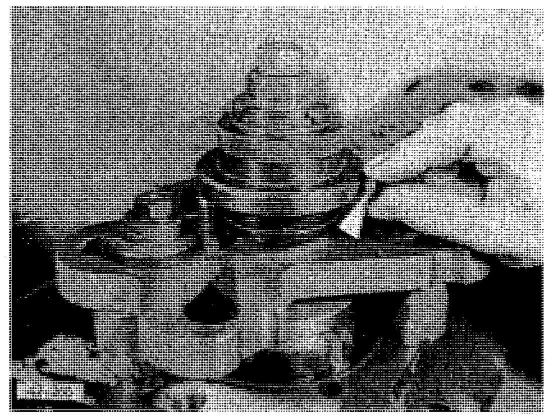
Note:

The selected cutting depth should not exceed 0.2 mm. The corresponding feed is given by a 1/8th turn (45°) of the knurled nut. The smaller the feed, the better is the depth of roughness of the reworked surface.
Fig. 4-16



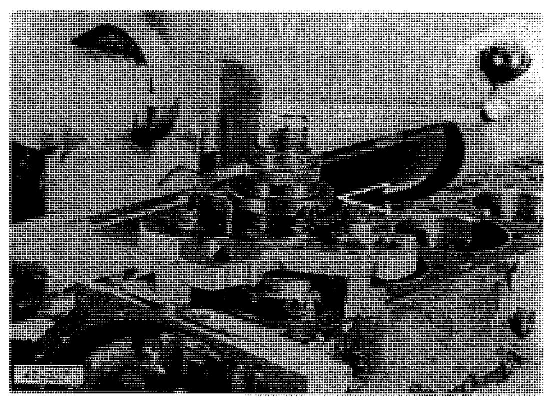
4-16

9. Following adjustment, lock device with setscrew.
Fig. 4-17



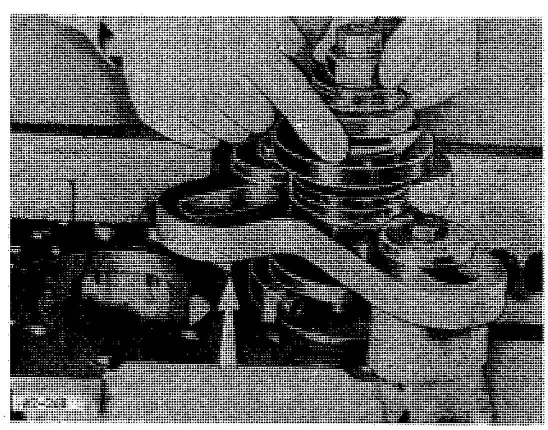
4-17

10. Turn spindle of device clockwise to reface the cylinder seating.
Fig. 4-18



4-18

11. Loosen setscrew. Raise tool from reworked surface by turning knurled nut. Remove refacing device.
Fig. 4-19

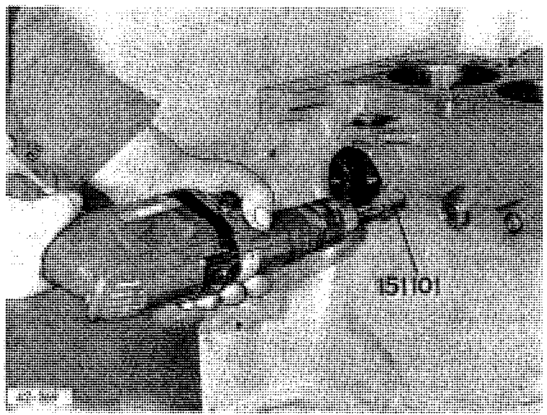


4-19

REMOVING AND REFITTING PISTON COOLING NOZZLES

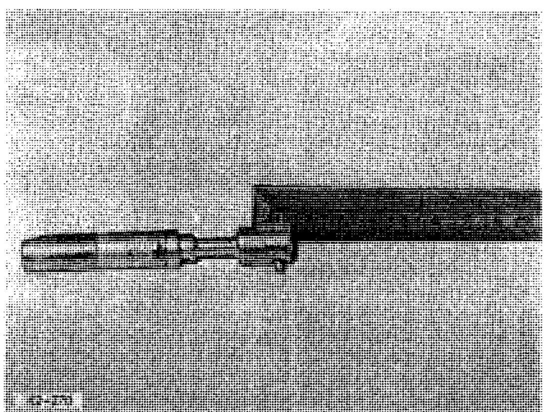
Special tools required:

Special device for piston cooling nozzles (complete) .... No. 151100
consisting of:
- o Drill-jig bush ..... No. 151101
- o Extractor bush with bolt .... No. 151102



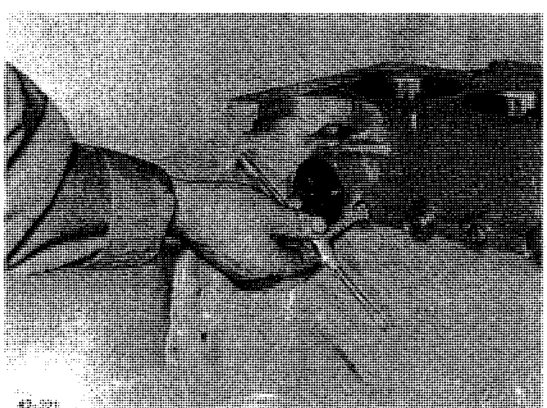
4/20

1. Place drill-jig bush in position and bore with 6.7 mm Ø drill.
Fig. 4-20



4-21

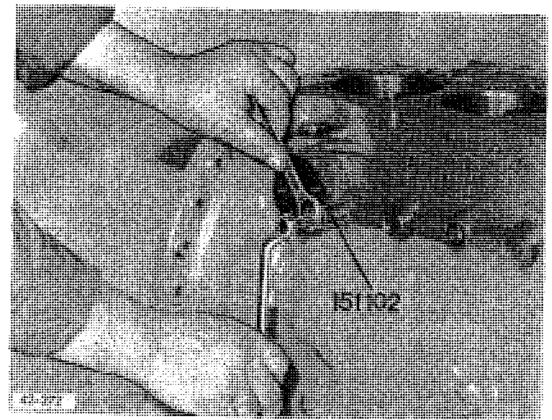
2. Boring depth max. 12 mm.
Fig. 4-21



4-22

3. Cut M8 thread.
Fig. 4-22

4. Pull out piston cooling nozzle by means of extractor bush and bolt.
Fig. 4-23



4-23

5. Fit O-seal on new piston cooling nozzle and apply a film of sealing compound.

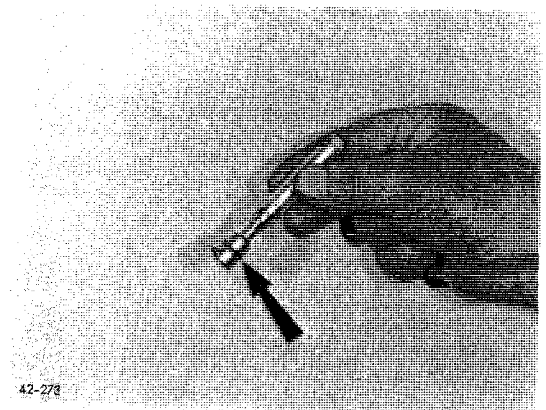
Fig. 4-24

Note:

Prior to installation, note diameter of nozzle bore:

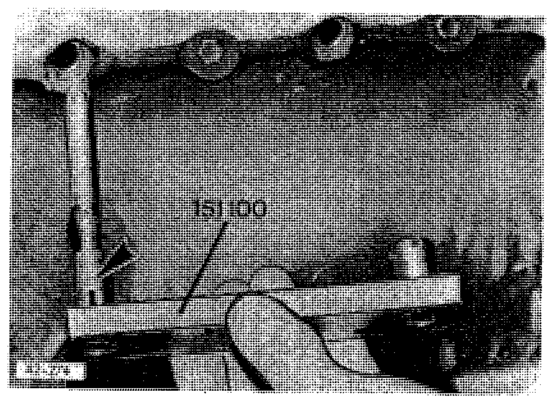
Ø = 0.8 mm

Ø = 1.5 mm



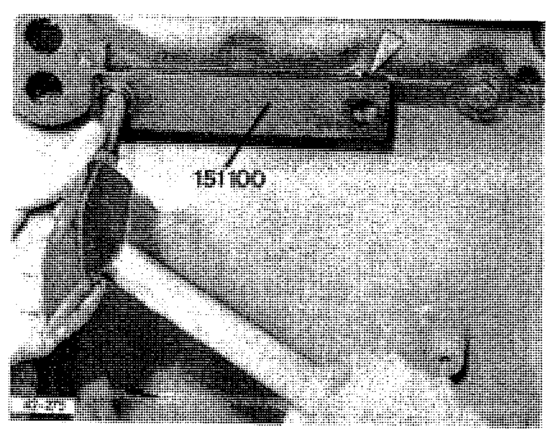
4-24

6. Insert piston cooling nozzle into pressing-in tool. The parallel pin must point upwards towards cylinder seating surface.
Fig. 4-25



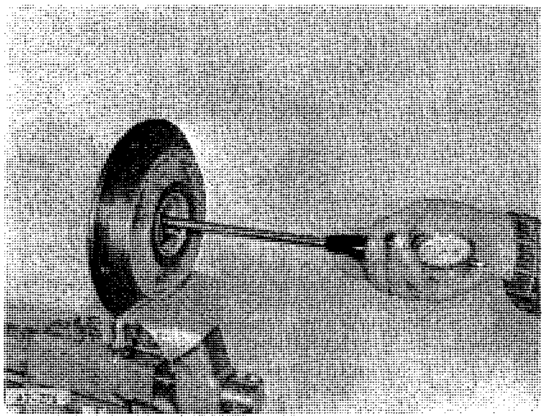
4-25

7. Install piston cooling nozzle. Pay attention to centering.
Fig. 4-26



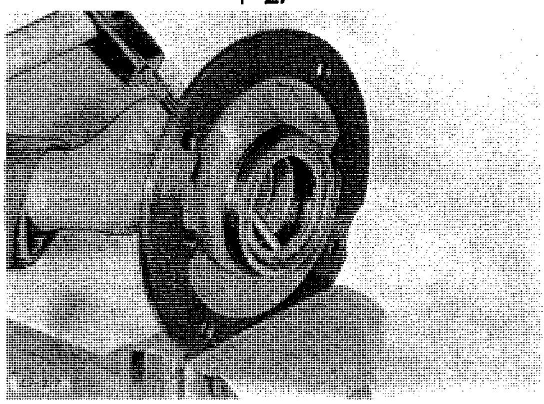
4-26

RENEWING BEARING BUSHES
- F2L 912 -



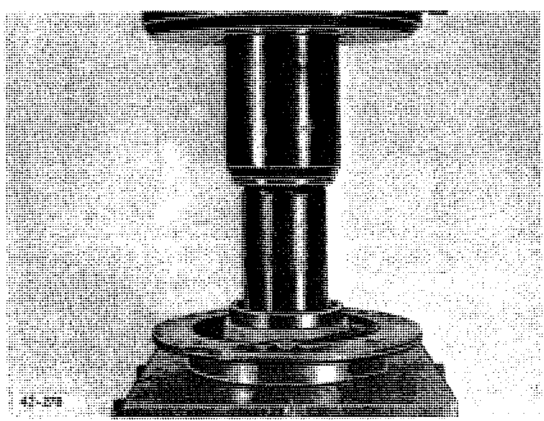
4-27

1. Gauge bearing bore.
Fig. 4-27



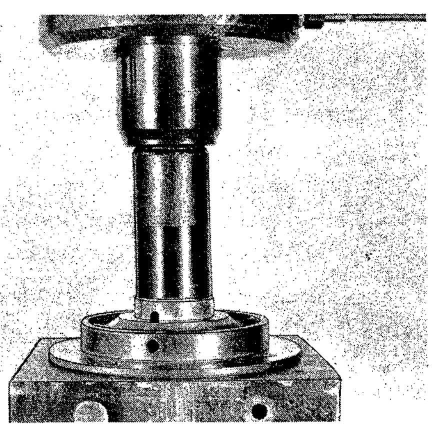
4-28

2. Drive out shaft seal.
Fig. 4-28



4-29

3. Press out old bearing bush.
Fig. 4-29



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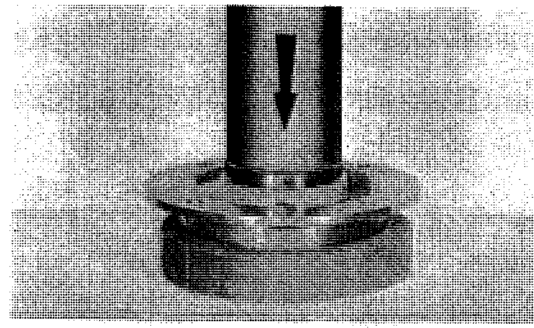
4-30

4. Press in new bearing bush flush, so that oil holes of bearing bush and endshield coincide.
Fig. 4-30

5. Press in new shaft seal flush.
Fig. 4-31

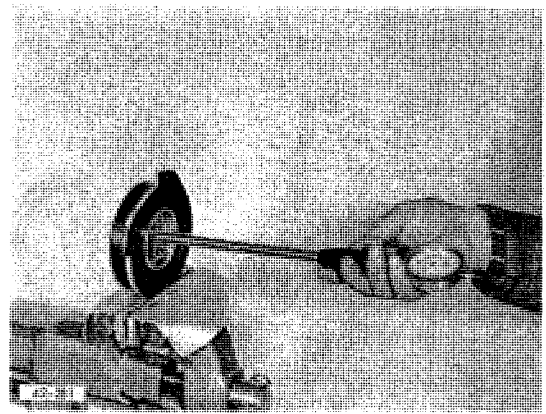


42-280

4-31

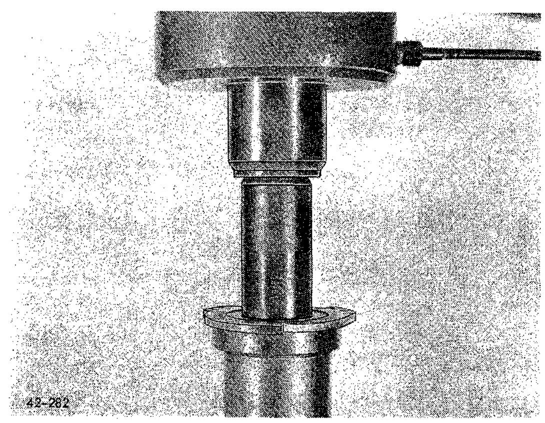
6. Gauge bearing bore of front endshield.
Fig. 4-32

551



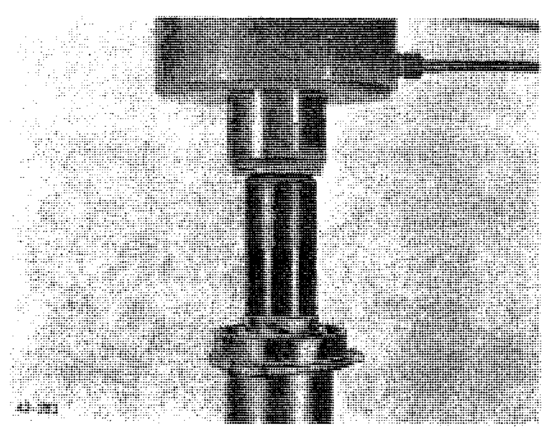
4-32

7. Press out old bearing bush.
Fig. 4-33

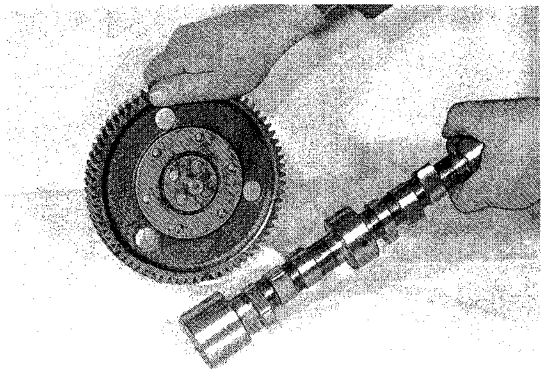


4-33

8. Pull in new bearing bush flush, so that oil holes of bearing bush and endshield coincide.
Fig. 4-34



4-34



42-284

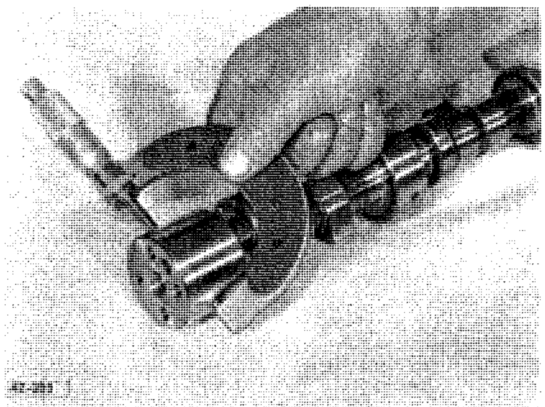
4-35

CHECKING, RENEWING CAMSHAFT AND BEARINGS - F2L 912 -

Special tool required:

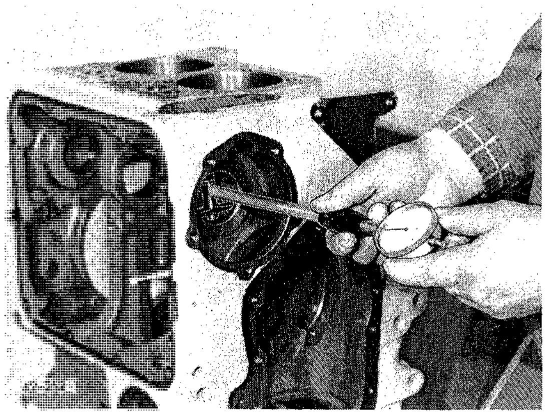
Extractor/Puller ..... No. 143630

1. Check camshaft and gear for wear.
Fig. 4-35



4-36

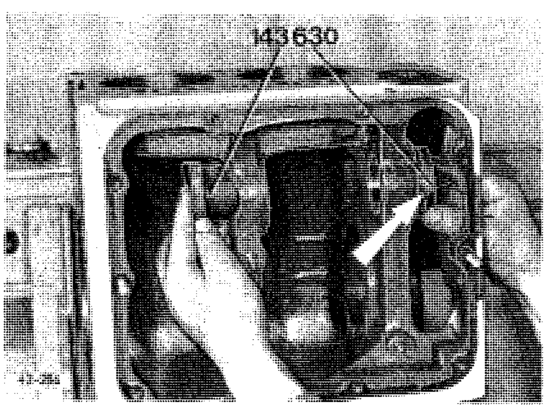
2. Gauge journal at drive and of camshaft.
Fig. 4-36



4-37

713
714

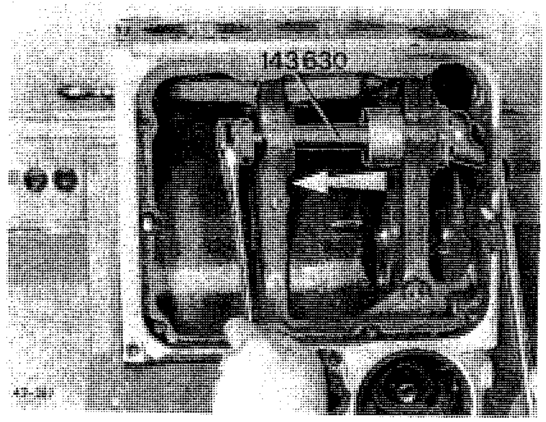
3. Gauge camshaft bearing bush.
Fig. 4-37



4-38

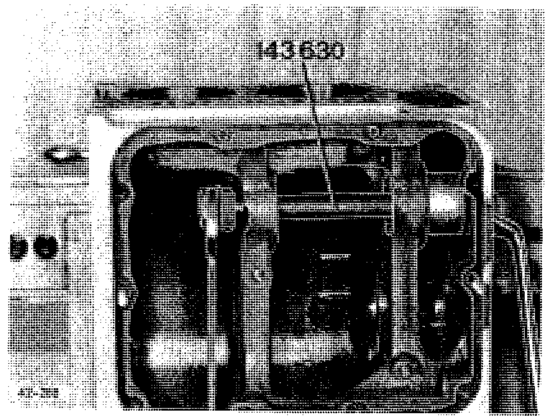
4. Renewing camshaft bearing bush: Apply thrust piece of device with the large diameter.
Fig. 4-38

5. Pull out camshaft bearing bush towards flywheel end.
Fig. 4-39



4-39

6. Position and pull in new bearing bush.
Fig. 4-40



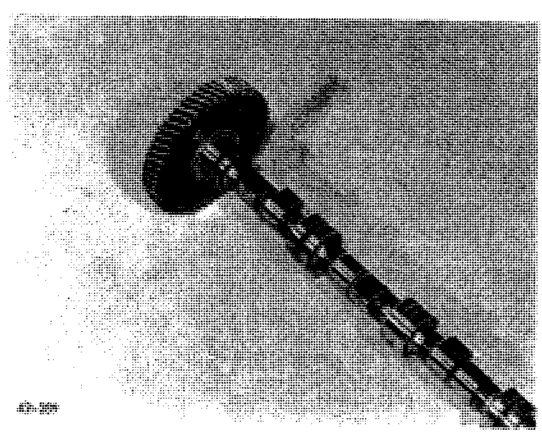
4-40

CHECKING, RENEWING CAMSHAFT AND BEARINGS
- as from 3-cyl. engine -

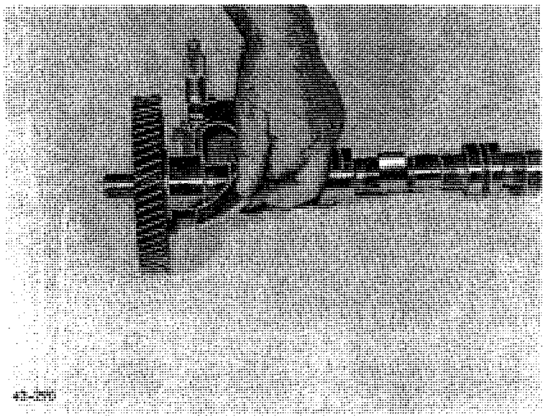
Special tool required:

Extractor/Puller ..... No. 143630

1. Check camshaft and gear for wear.
Fig. 4-41

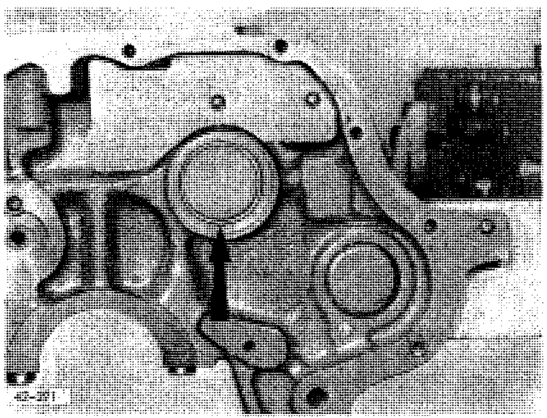


4-41

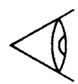


4-42

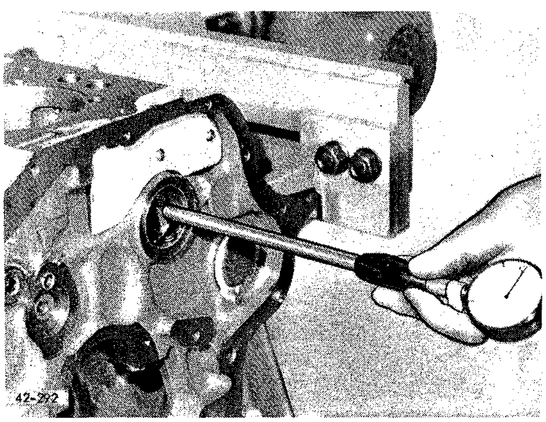
2. Gauge journal.
Fig. 4-42



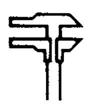
4-43

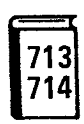


3. Check camshaft bearing bush for damage.
Fig. 4-43

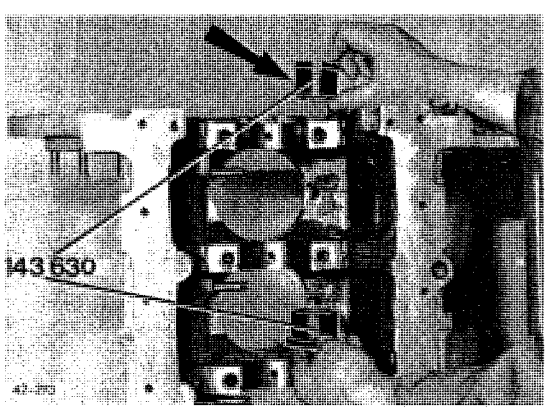


4-44





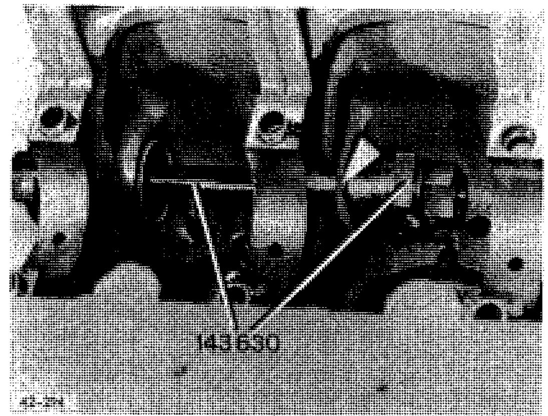
4. Gauge camshaft bearing bush.
Fig. 4-44



4-45

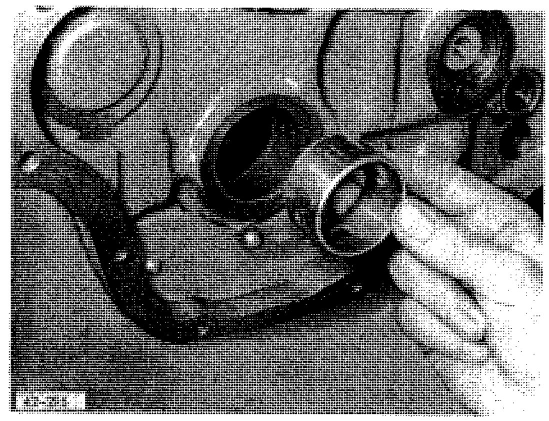
5. Renewing camshaft bearing bush: Apply thrust piece of device with the small diameter.
Fig. 4-45

6. Support anchor of device at the next camshaft bearing bore. Pull out bearing bush towards flywheel end.
Fig. 4-46



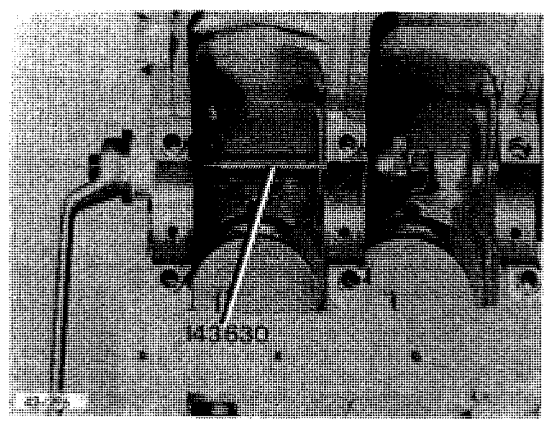
4-46

7. Position new bearing bush, making sure that oil holes coincide.
Fig. 4-47



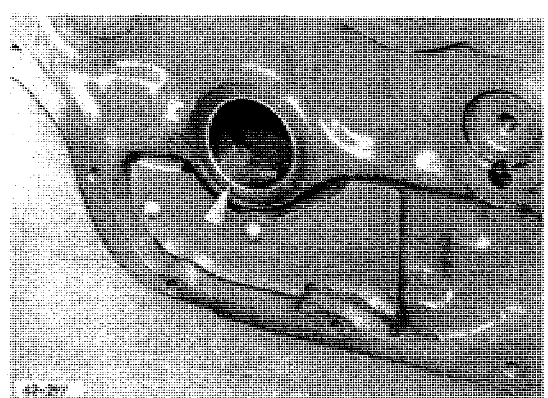
4-47

8. Press in bearing bush with special tool ...
Fig. 4-48



4-48

... until flush.
Fig. 4-49



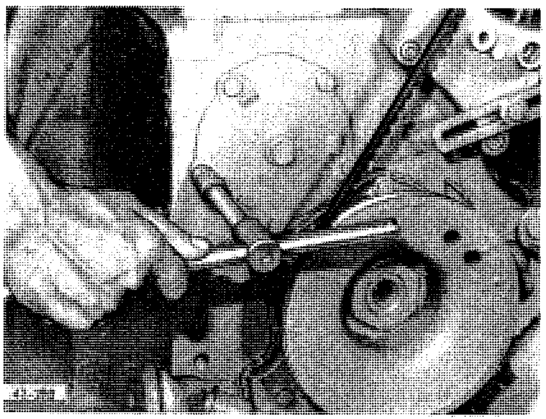
4-49

REMOVING AND REFITTING CAMSHAFT
- F2L 912 -

Special tool required:

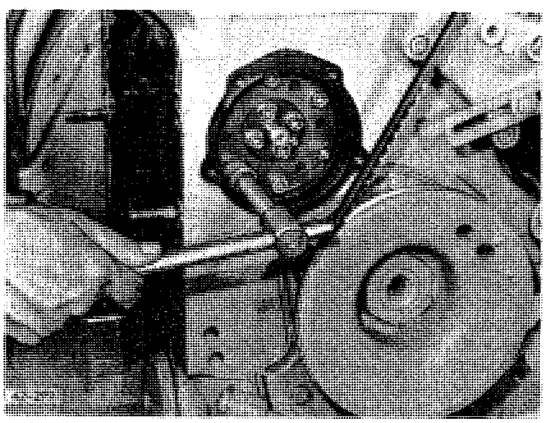
Retainer .... No. 143400

The injection pump is removed.
See Chapter 7.



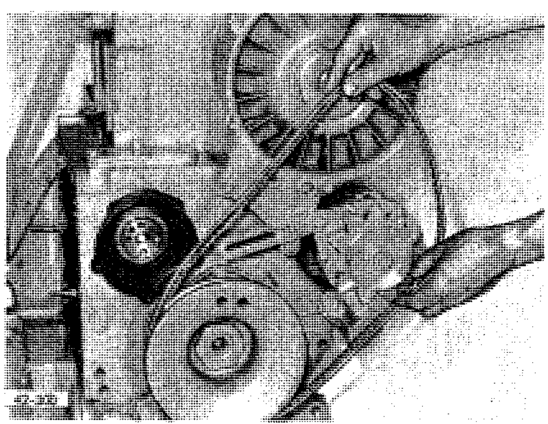
4-50

1. Remove front camshaft cover.
Fig. 4-50



4-51

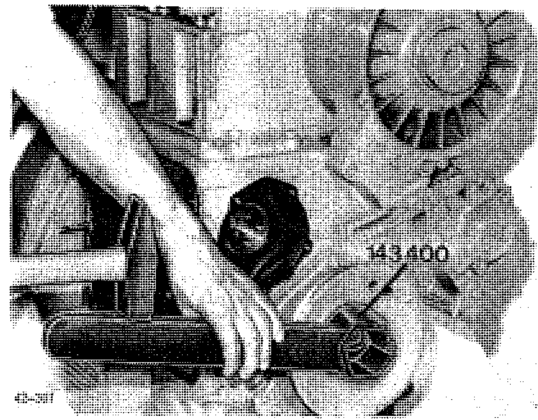
2. Remove eccentric ring for feed pump.
Fig. 4-51



4-52

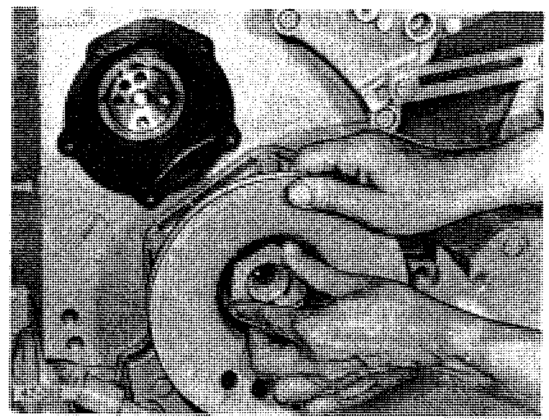
3. Remove V-belt.
Fig. 4-52

4. Undo nut for V-belt pulley.
Fig. 4-53



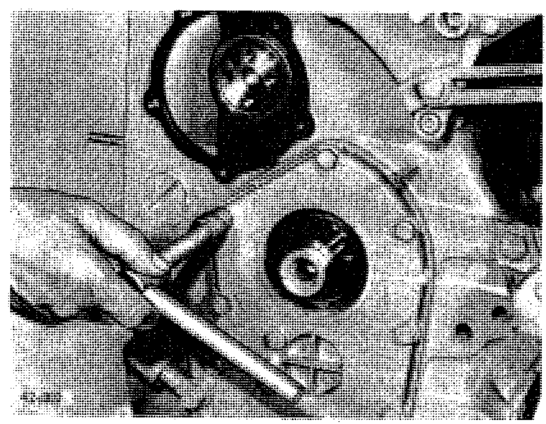
4-53

5. Take off V-belt pulley.
Fig. 4-54



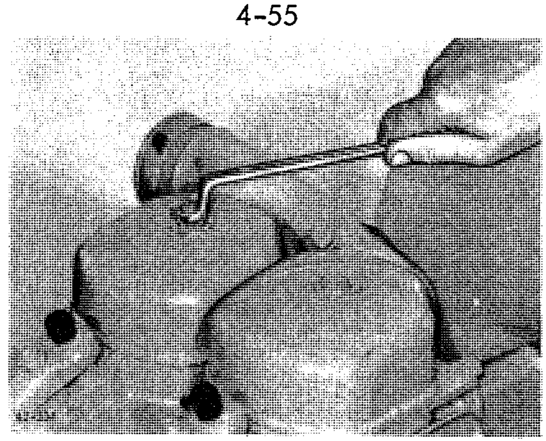
4-54

6. Remove front cover.
Fig. 4-55

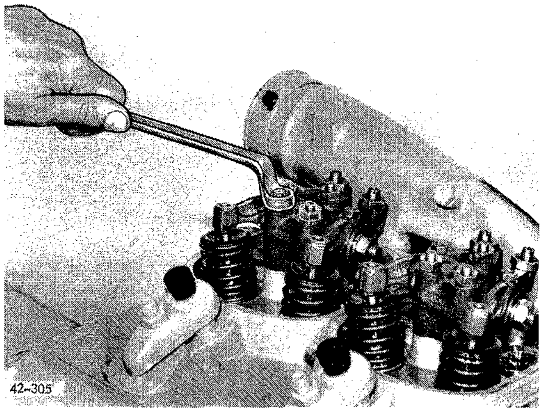


4-55

7. Remove rocker chamber covers.
Fig. 4-56



4-56

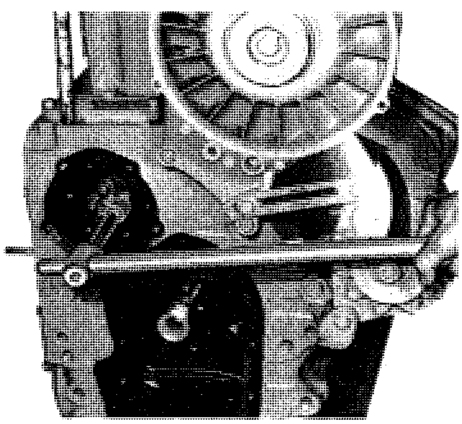


4-57

8. Remove rocker arm brackets.
Fig. 4-57

4-58

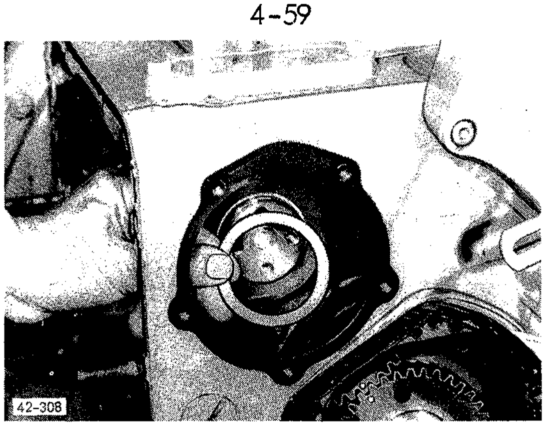
9. Take out pushrods.
Fig. 4-58



42-307

4-59

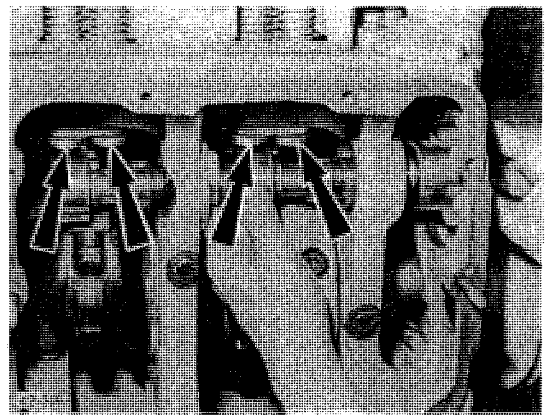
10. Remove camshaft gear.
Fig. 4-59



4-60

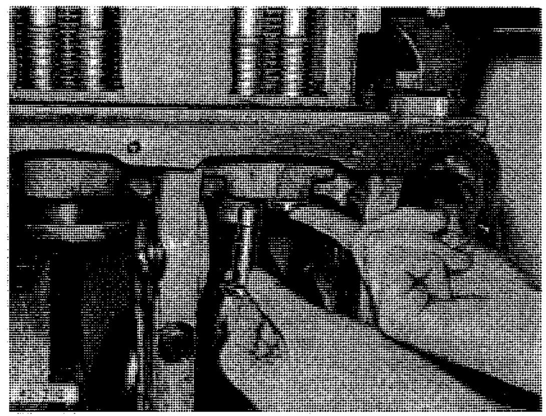
11. Take out stop washer.
Fig. 4-60

12. Hold up tappets. Remove camshaft and tappets.
Fig. 4-61



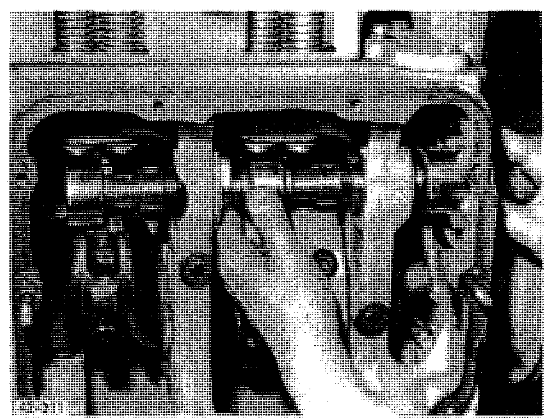
4-61

13. Insert and hold oiled tappets to install camshaft.
Fig. 4-62



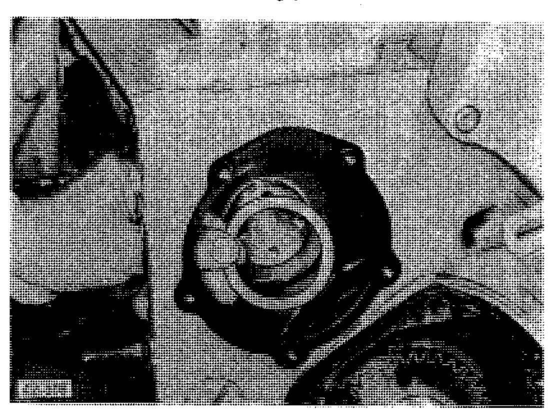
4-62

14. Introduce camshaft through the bearing bores.
Fig. 4-63

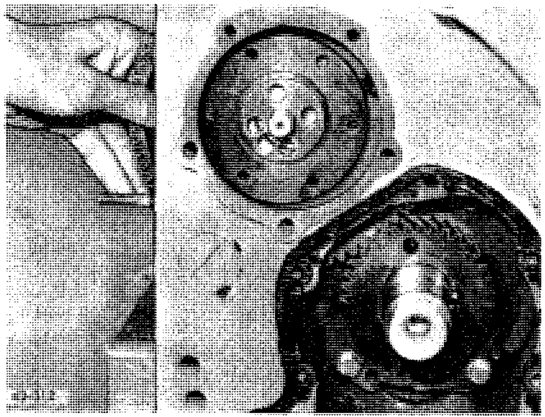


4-63

15. Place stop washer in position on camshaft.
Fig. 4-64

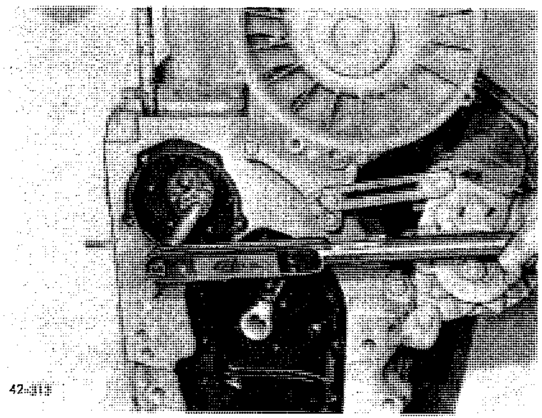


4-64



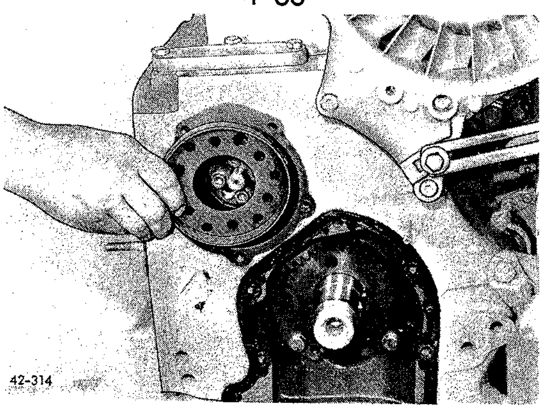
4-65

16. Match up and mount camshaft gear in accordance with markings.
Fig. 4-65



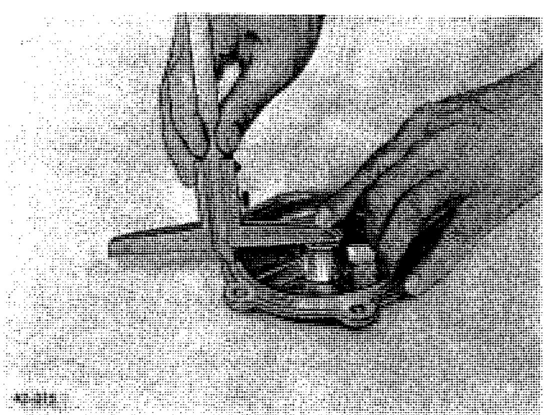
4-66

17. Tighten fastening bolts of camshaft gear as specified.
Fig. 4-66



4-67

18. Mount eccentric ring on camshaft gear.
Fig. 4-67



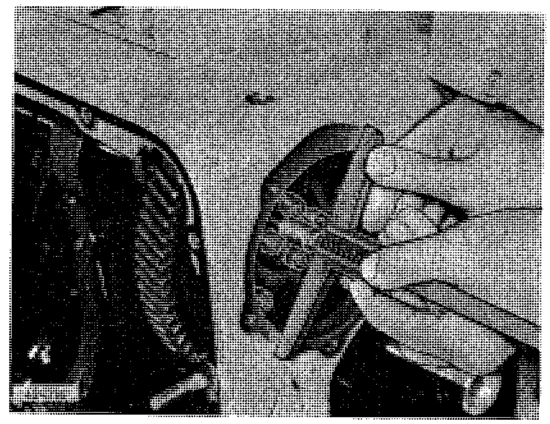
4-68

19. Measure at camshaft cover the overhang of butting face relative to sealing surface with gasket.
Fig. 4-68

20. Measure set-back of contact surface at counter bolt relative to sealing surface at crankcase. The difference between the two measurements is the camshaft axial clearance (end float).

Note:

When measuring, press back camshaft as far as possible.
Fig. 4-69

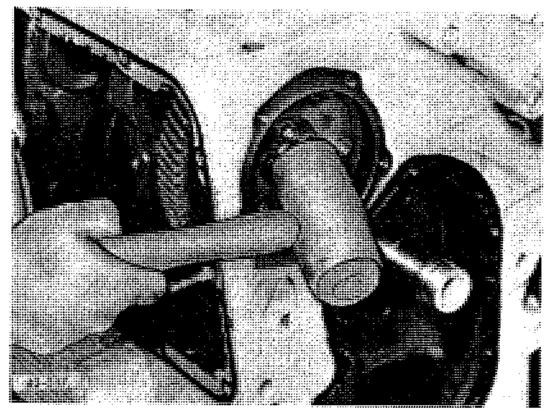


4-69

21. To correct the end float, drive counter bolt inwards.

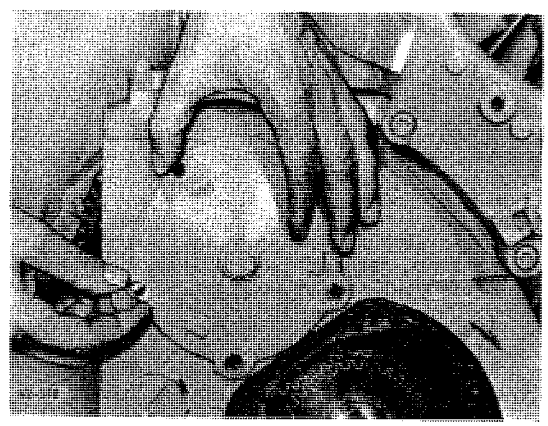
Note:

See also Chapter 9, Fig. 9-81
Fig. 4-70



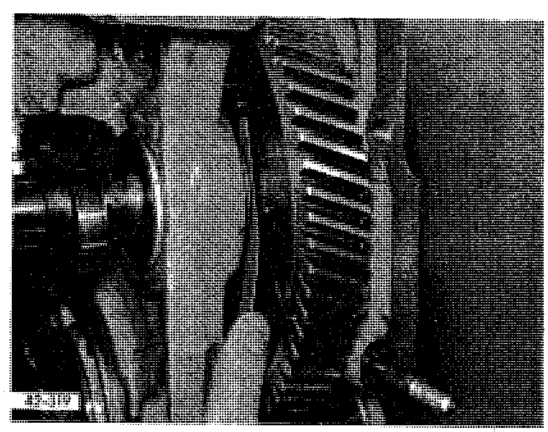
4-70

22. Mount camshaft cover c/w new gasket.
Fig. 4-71

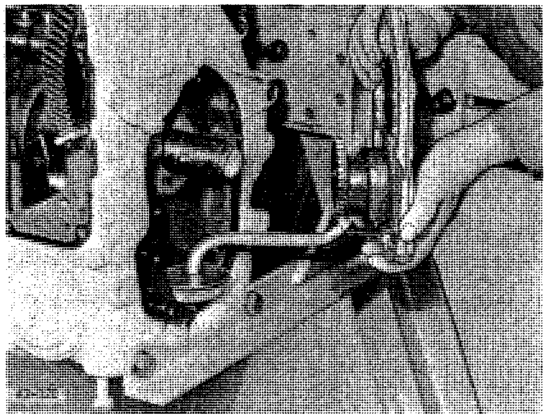


4-71

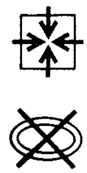
23. Check camshaft end float with feeler gauge.
Fig. 4-72



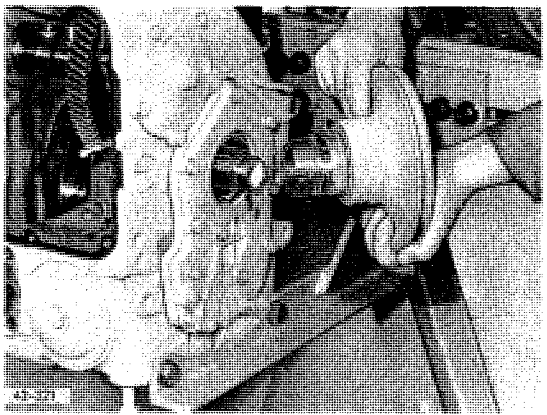
4-72



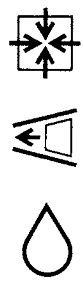
4-73



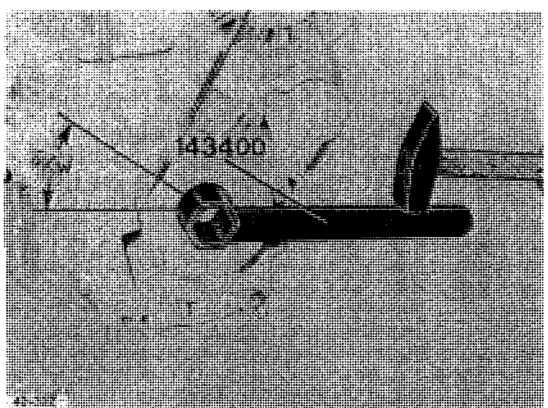
24. Mount front cover c/w new gasket and oil pump.
Fig. 4-73



4-74



25. o Oil shaft seal.
    o Push on V-belt pulley over key.
Fig. 4-74



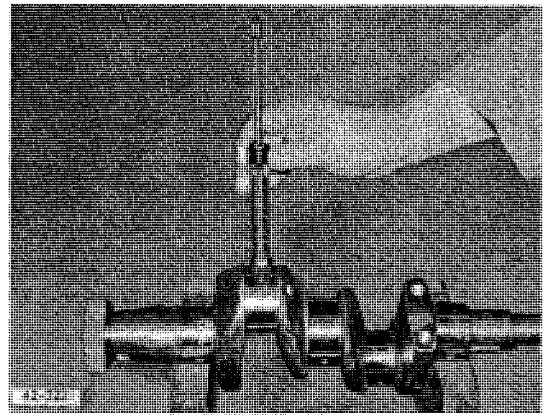
4-75

26. Screw on nut by hand and tighten as specified. Set valve clearance (see Chapter 2).
Mount injection pump (see Chapter 7).
Fig. 4-75

CHECKING AND GAUGING CRANKSHAFT

1. Support crankshaft at jouranls. Check hardness with scleroscope.
Fig. 4-76

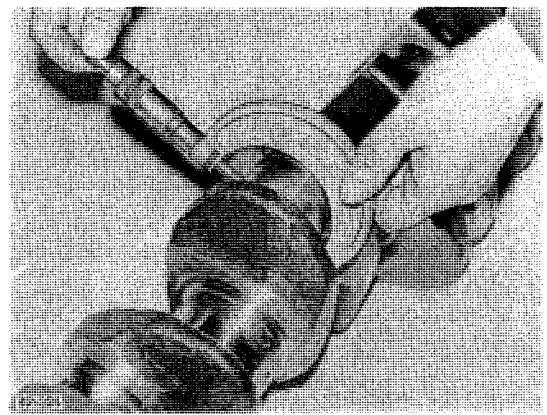
518
529



4-76

2. Gauge journals
Fig. 4-77

510
520



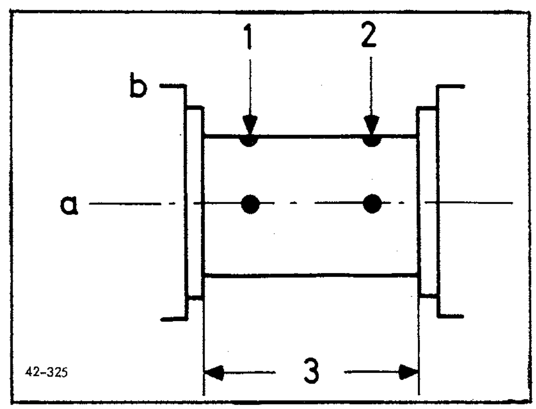
4-77

3. Gauge journals at points 1 and 2 in planes "a" and "b".

Note:

At locating bearing, gauge also dimension "3".
Fig. 4-78

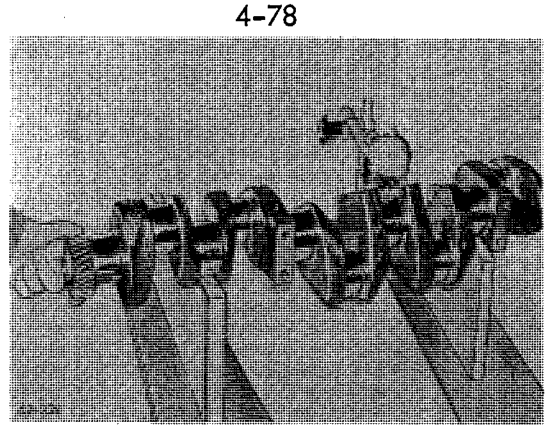
540



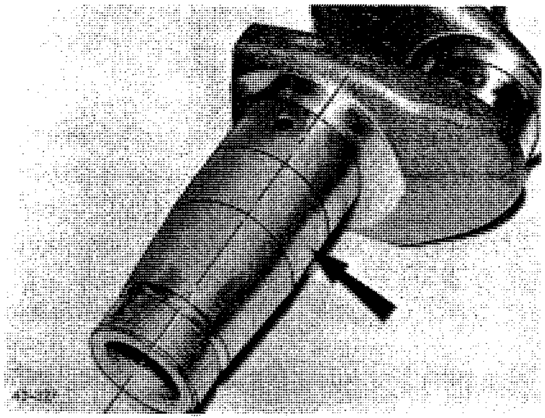
4-78

4. Check crankshaft for true running.
Fig. 4-79

527



4-79

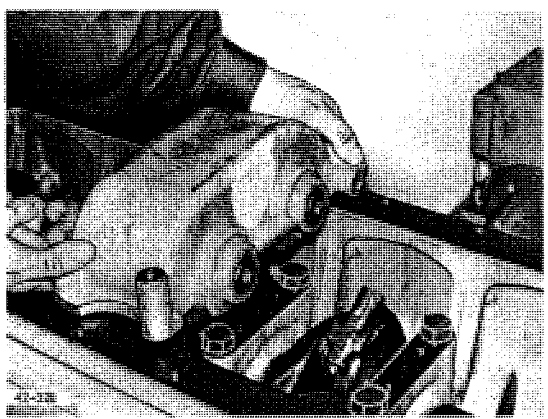


4-80

5. Inspect shaft seal running surface.
Fig. 4-80

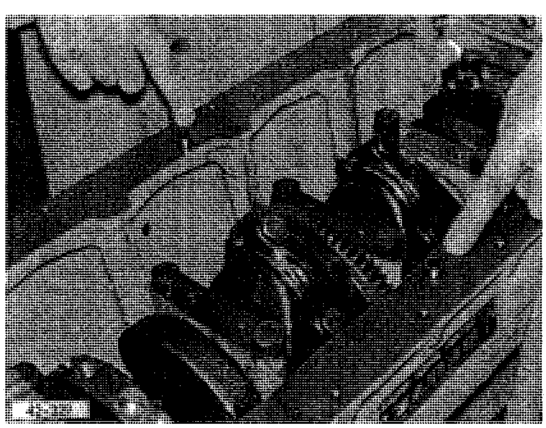
REMOVING AND REFITTING MASS BALANCING GEAR (MAG) - CENTRAL DRIVE -

Oilpan is removed.



4-81

1. Remove oil suction pipe and mass balancing gear.
Fig. 4-81



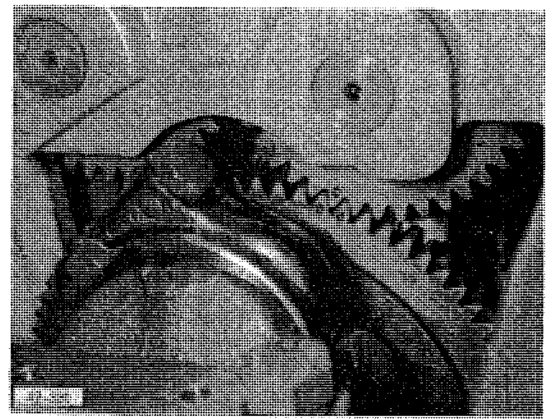
4-82

2. Check presence of two dowel sleeves.
Fig. 4-82

3. Place on mass balancing gear, while matching up the punch marks on the gears.

Note:

Oil mass balancing gear prior to installation.
Fig. 4-83

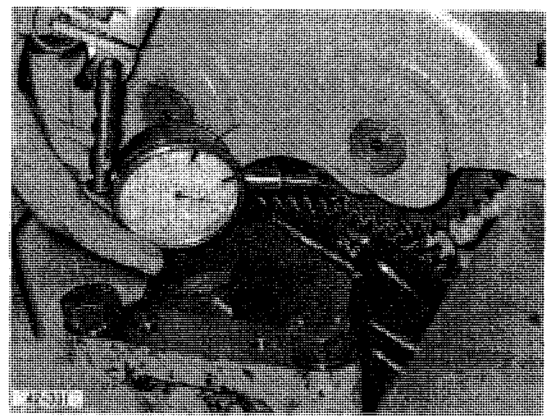


4-83

4. Secure mass balancing gear and gauge backlash of teeth.

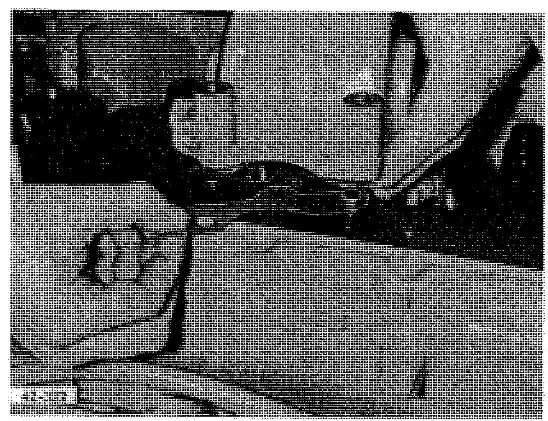
Note:

Backlash of teeth: Aim at min. set value with engine in normal position, and at max. set value with engine turned over by 180° - see photograph.
Fig. 4-84



4-84

5. Make up for backlash deviations with spacer plates.
Fig. 4-85

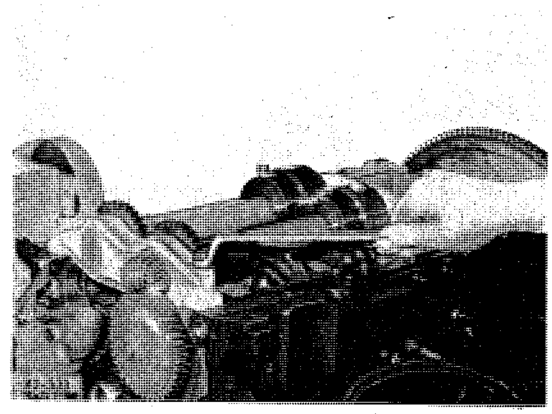


4-85

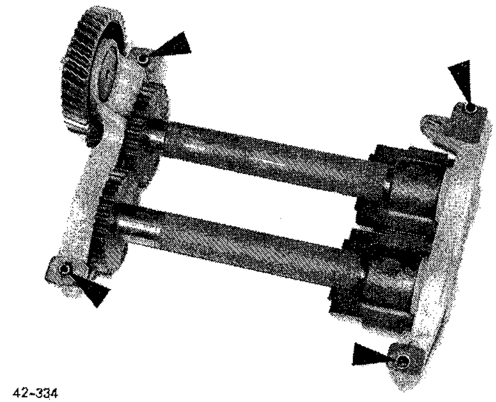
REMOVING AND REFITTING MASS BALANCING GEAR (MAG) - FRONT-END DRIVE -

Oilpan, cooling blower, front cover and oil suction pipe are removed.

1. Screw out bolts at bearing cross members and take out mass balancing gear.
Fig. 4-86

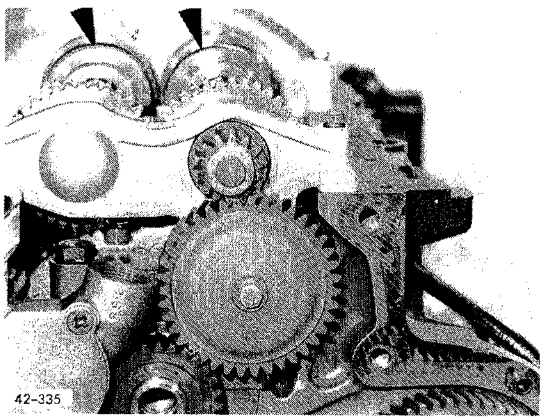


4-86



4-87

2. Insert dowel sleeves for bearing cross members.
Fig. 4-87



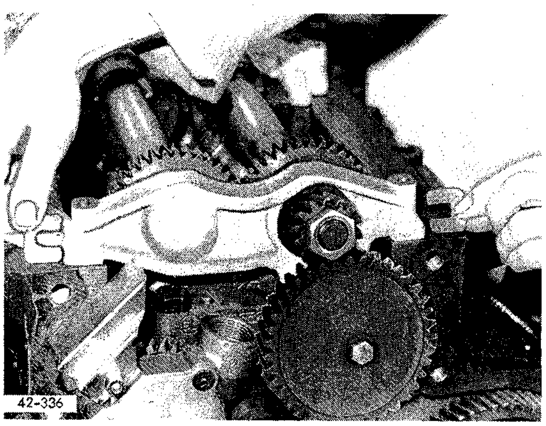
4-88

3. Mounting complete mass balancing gear (MAG):

- Turn crankshaft to TDC position, cylinder No. 1.
- Match MAG drive gear to crankshaft gear according to marking.

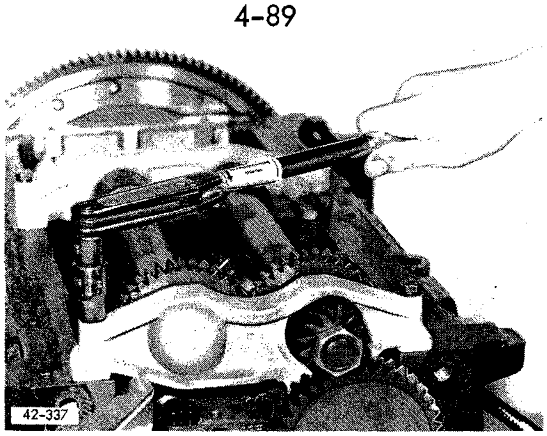
Note:

The balancing weights on the MAG shafts must point towards oilpan.
Fig. 4-88



4-89

Presetting of teeth backlash: Use spacer plates of 0.1 or 0.3 mm thickness to preset teeth backlash at front bearing cross member.
Fig. 4-89



4-90

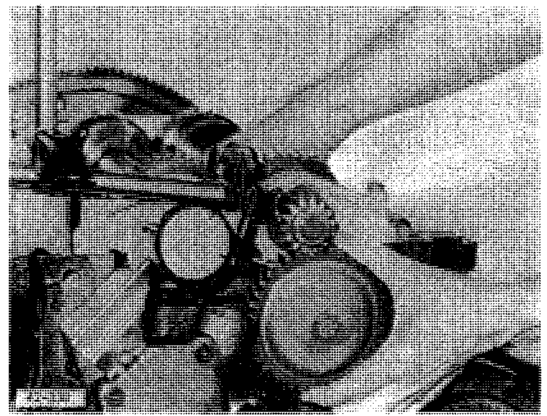
4. Tighten bolts for bearing cross members as specified.
Fig. 4-90

922

5. Gauge teeth backlash between crankshaft gear and MAG drive gear.

Note:

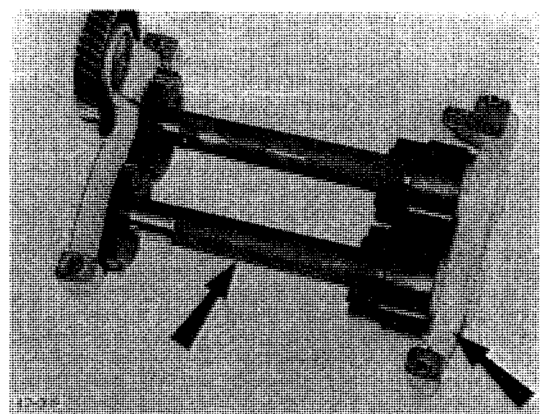
Backlash of teeth: Aim at min. set value with engine in normal position, and at max. set value with engine turned over by 180°.
Fig. 4-91



4-91

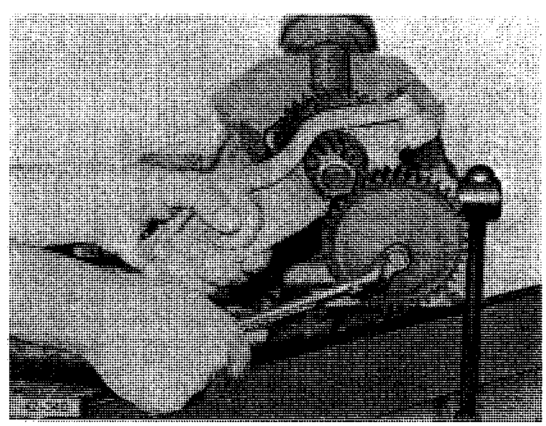
DISMANTLING AND REASSEMBLING MASS BALANCING GEAR

1. Remove rear bearing cross member and driven shaft. Check parts for wear.
Fig. 4-92

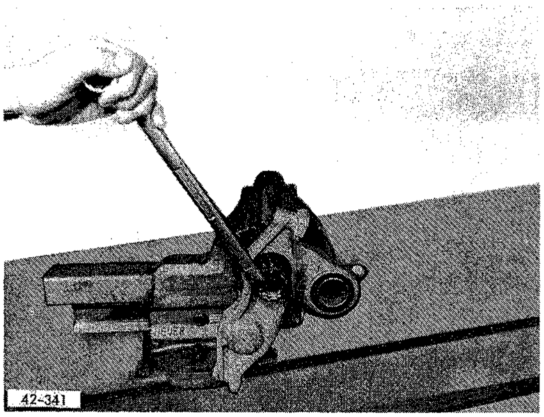


4-92

2. Clamp drive shaft with front bearing cross member in vice. Screw out hex. bolt for drive gear. Take off drive gear.
Fig. 4-93

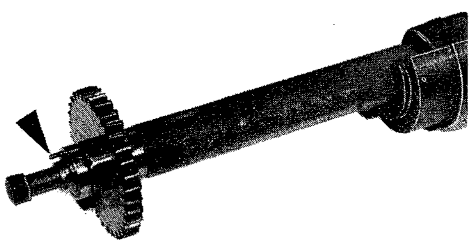


4-93



4-94

3. Screw off nut for pinion. Remove pinion and bearing cross member.
Fig. 4-94



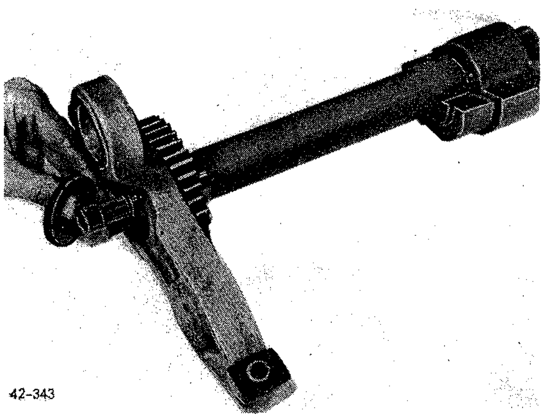
42-342

4-95

4. Insert dowel sleeve in drive shaft.

Note:

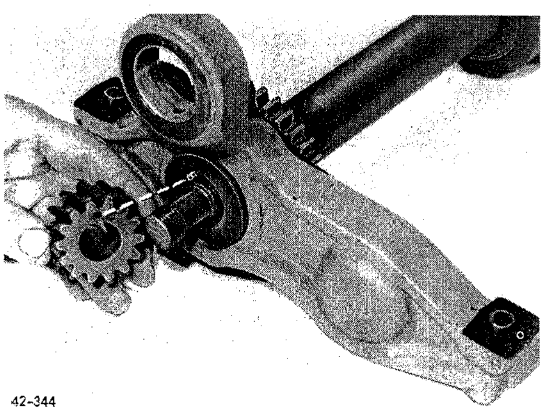
Oil bearing parts prior to assembly.
Fig. 4-95



42-343

4-96

5. Guide shaft into front bearing cross member. Line up stop washer with recess towards dowel sleeve and place in position.
Fig. 4-96



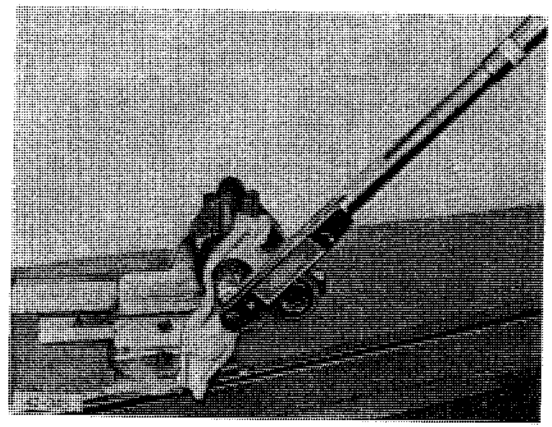
42-344

6. Push on pinion.
Fig. 4-97

4-97

7. Clamp drive shaft in vice. Tighten hex. nut as specified.
Fig. 4-98

923

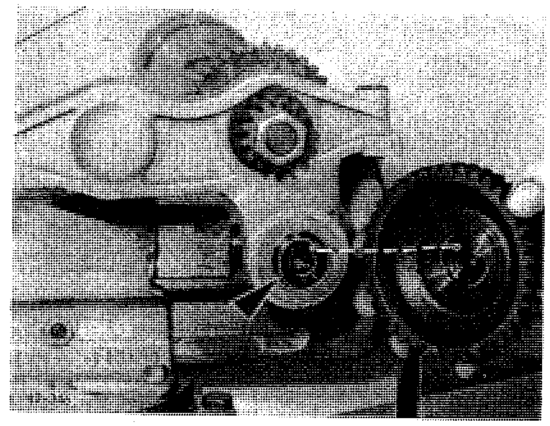


4-98

8. Insert journal in CROSS MEMBER. Push on drive gear.

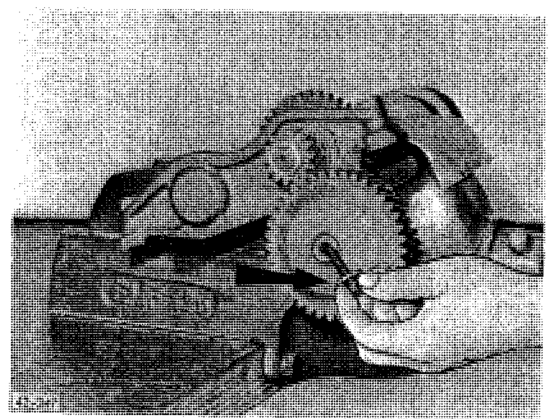
Note:

Observe gear markings relative to pinion.
Fig. 4-99



4-99

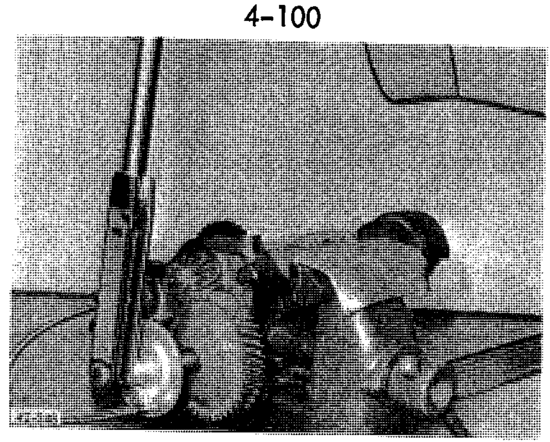
9. Insert hex. bolt with washer (arrow) in drive gear.
Fig. 4-100



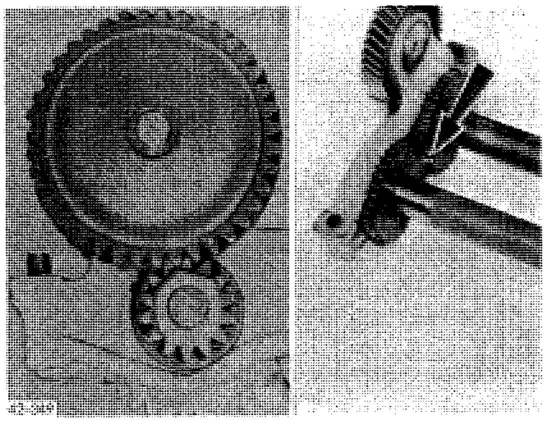
4-100

10. Tighten hex. bolt as specified.
Fig. 4-101

924



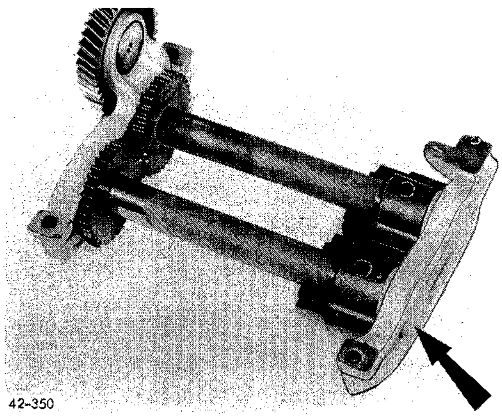
4-101



4-102

11. Match up punch marks of pinion and drive gear (photo, left).

12. Insert driven shaft in front bearing cross member, while matching gears according to markings (photo, right).
Fig. 4-102



4-103

13. Place rear bearing cross member onto shafts.
Fig. 4-103

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5. Blower End

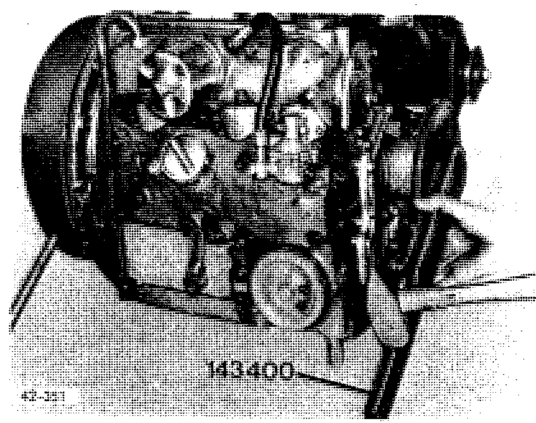
Page

REMOVING, REFITTING FRONT SHAFT SEAL OF CRANKSHAFT - F2L 912 -

Special tools required:

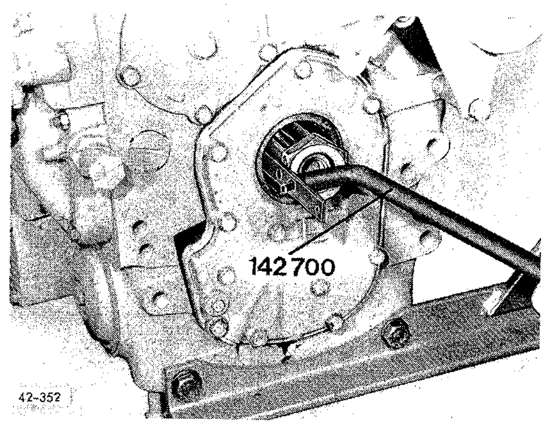
Fitting device .... No. 142500
Extractor .... No. 142700
Retainer .... No. 143400

1. Lock flywheel. Undo nut of V-belt pulley. Take off pulley.
Fig. 5-1



5-1

2. Withdraw shaft seal by means of extractor.
Fig. 5-2

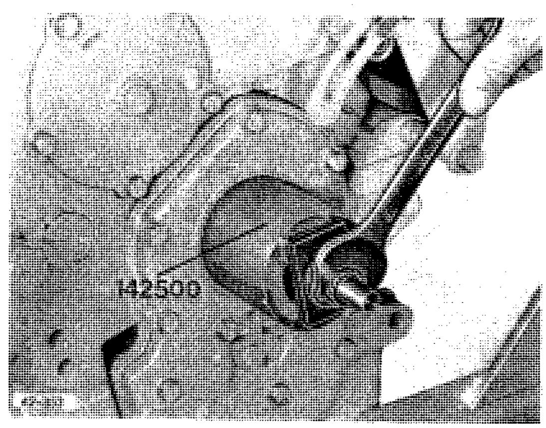


5-2

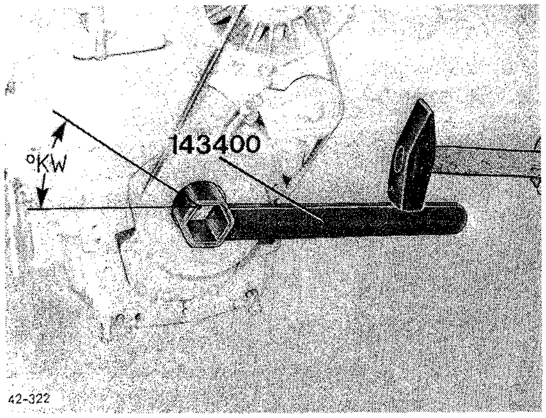
3. Oil shaft seal and press in with fitting device.

Note:

Displace shaft seal axially in case of run-in track.
Fig. 5-3

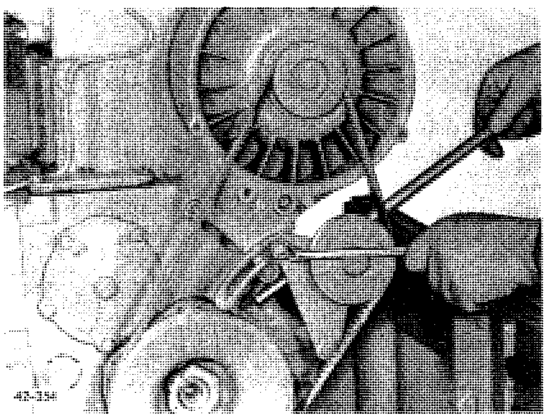


5-3



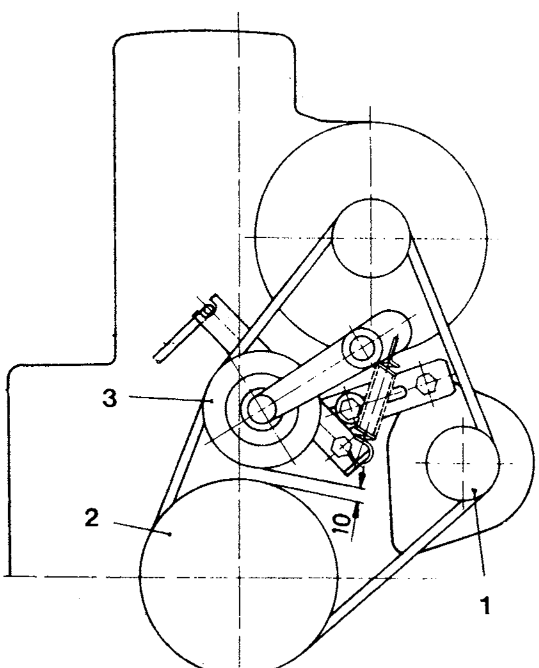
5-4

4. Mount V-belt pulley and tighten nut as specified, while securely locking the flywheel.
Fig. 5-4



5-5

5. Place on and tension V-belt, tighten bolt.
Fig. 5-5



5-6

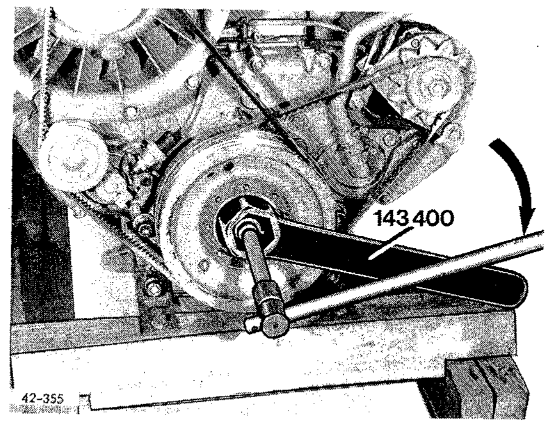
6. V-belt tensioner with shutdown device: Tension V-belt by means of alternator -1- until a distance of at least 10 mm results between V-belt pulley -2- and tensioning pulley -3-.
Fig. 5-6

REMOVING, REFITTING FRONT SHAFT SEAL OF CRANKSHAFT
- as from 3-cyl. engine -

Special tools required:

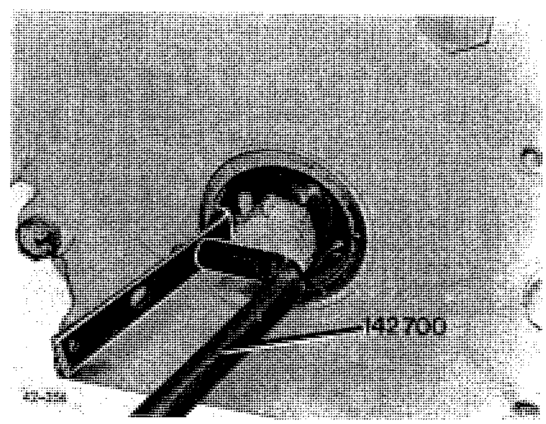
Degree gauge .... No. 101910
Fitting device .... No. 142520
Extractor .... No. 142700
Retainer .... No. 143400

1. Lock V-belt pulley by means of retainer and screw out bolt (left-hand thread!). Take off V-belt pulley.
Fig. 5-7



5-7

2. Withdraw shaft seal by means of extractor.
Fig. 5-8

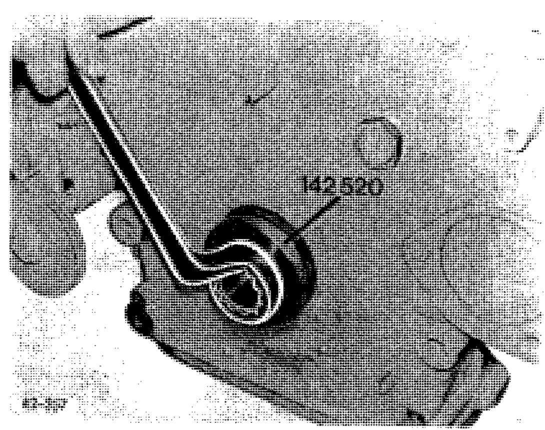


5-8

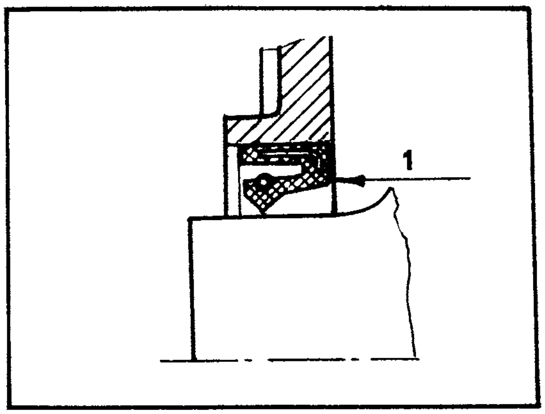
3. Press in shaft seal with fitting device.

Note:

Displace shaft seal axially in case of run-in track.
Fig. 5-9



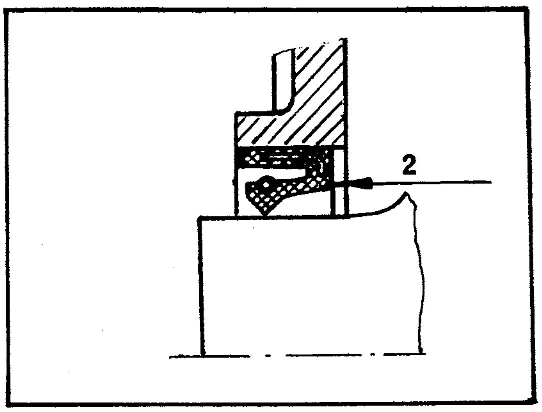
5-9



5-10

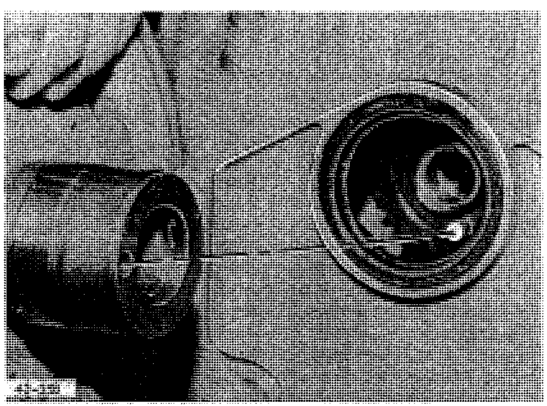
Nota:

When moving radial seal, observe correct depth of installation (pressure in). Depth 1 see Fig. 5-10, outside flush with frontend cover.



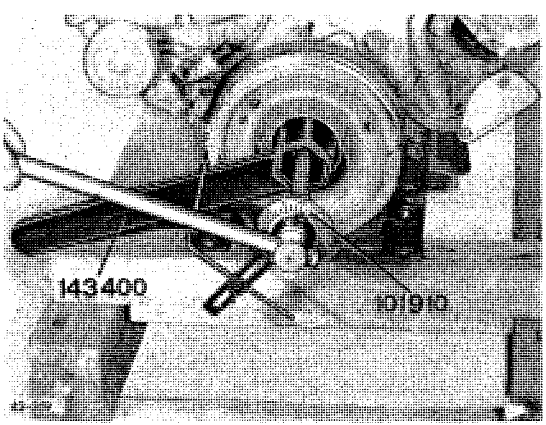
5-11

Depth 2 (after shifting in front-end cover to be flush inside): max. 1.0 mm.
Fig. 5-11



5-12

4. Grease sealing lip of shaft seal and also contact surface on V-belt pulley.
Fig. 5-12



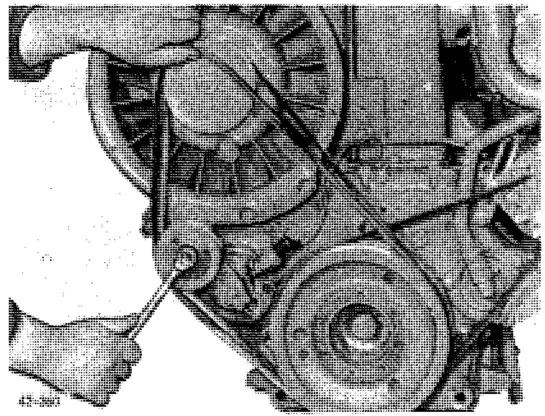
5-13

5. Lock V-belt pulley by means of retainer. Using degree gauge, tighten bolt as specified.

Note:

Bolt has left-hand thread!
Fig. 5-13

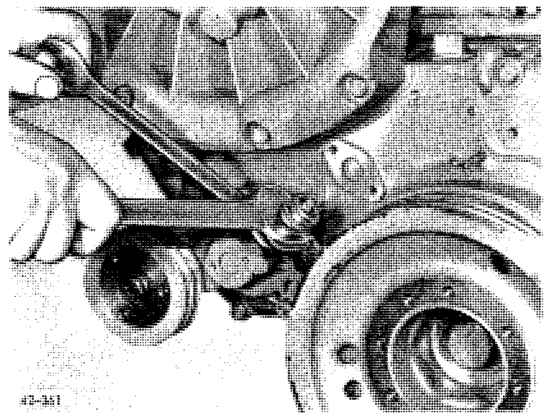
6. Place on V-belt.
Fig. 5-14



5-14

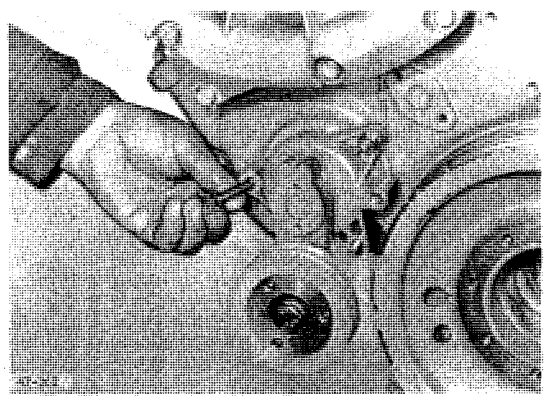
REMOVING V-BELT TENSIONER
- as from 3-cyl. engine -

1. Take off V-belt. Screw off warning switch.
Fig. 5-15



5-15

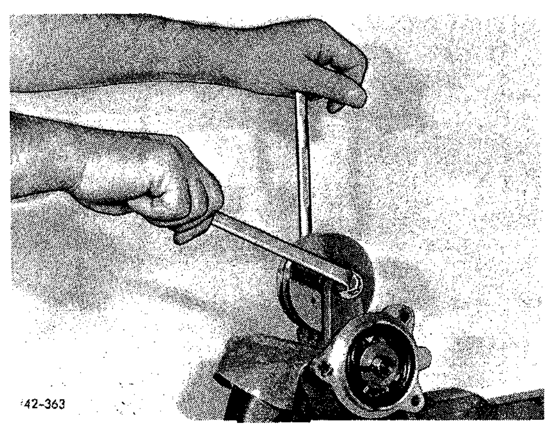
2. Remove V-belt tensioner.
Fig. 5-16



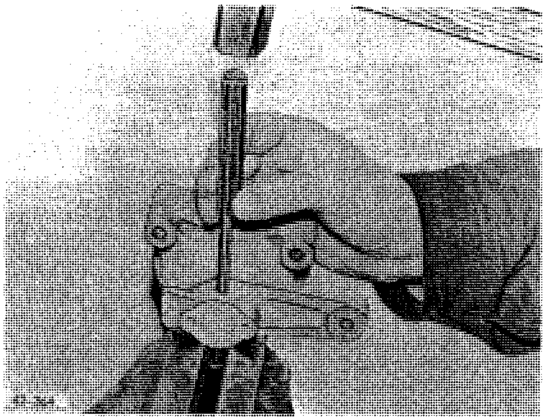
5-16

CHECKING, RECONDITIONING V-BELT TENSIONER

1. Screw off tensioning pulley.
Fig. 5-17

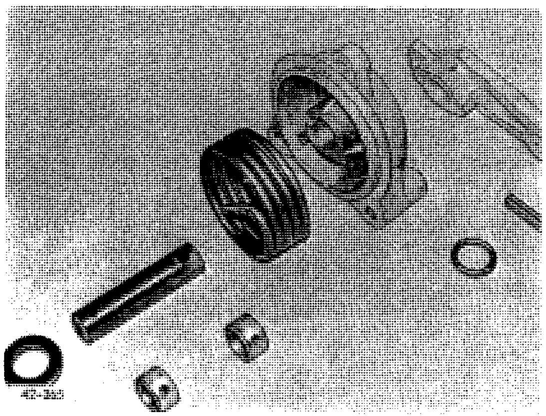


5-17



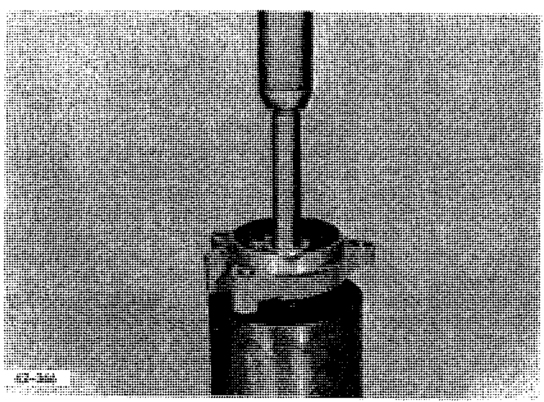
5-18

2. Remove pulley lever.
Fig. 5-18



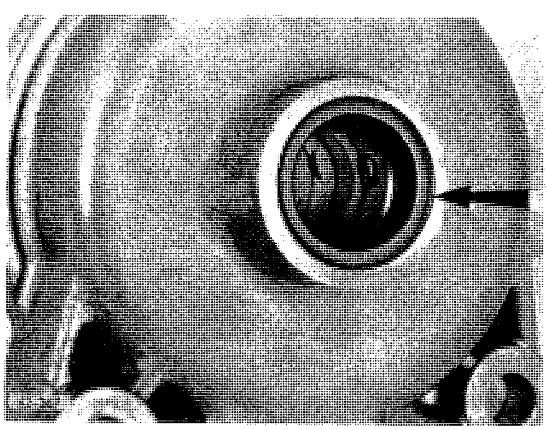
5-19

3. Dismantle V-belt tensioner, check components.
Fig. 5-19



5-20

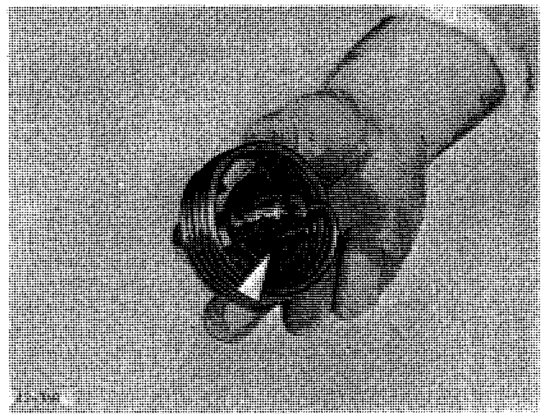
4. Press in bearing bushes.
Fig. 5-20



5-21

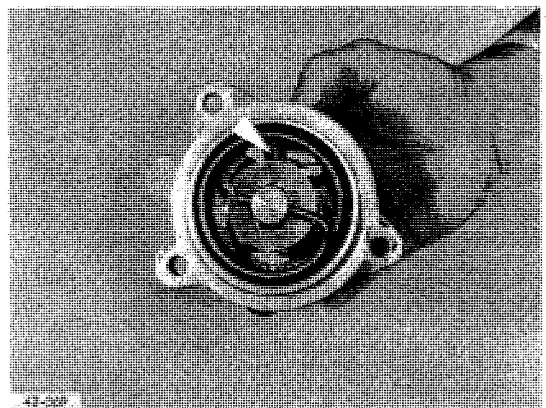
5. Press in shaft seal, flush at outer side.
Fig. 5-21

6. Push long end of torsion spring into shaft and place in spacer washer.
Fig. 5-22



5-22

7. Guide shaft with torsion spring and spacer washer into housing. Position for short end of torsion spring: see arrow.
Fig. 5-23

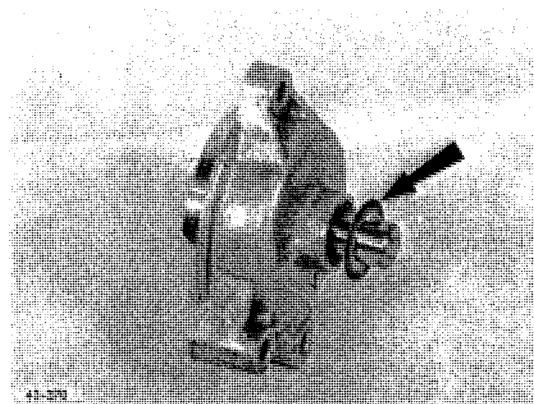


5-23

8. Mount shim.

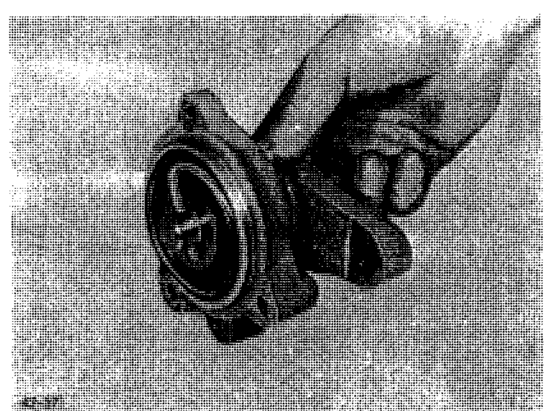
Note:

Shim thickness is 0.35 mm.
Fig. 5-24

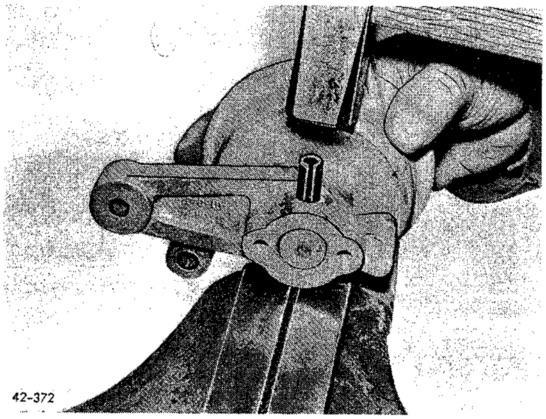


5-24

9. Mount pulley lever onto shaft, taking care that the locking pin bores of shaft and pulley lever concide. Long end of torsion spring points downwards.
Fig. 5-25

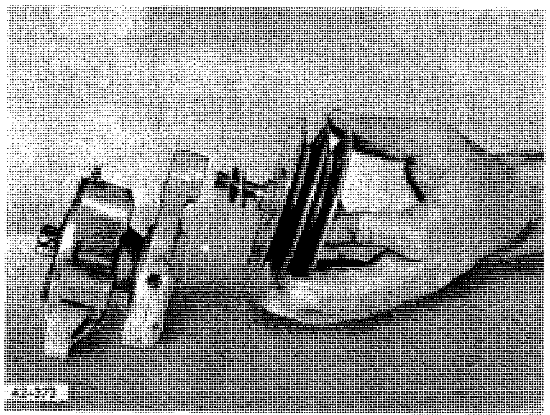


5-25



5-26

10. Drive in locking pin.
Fig. 5-26

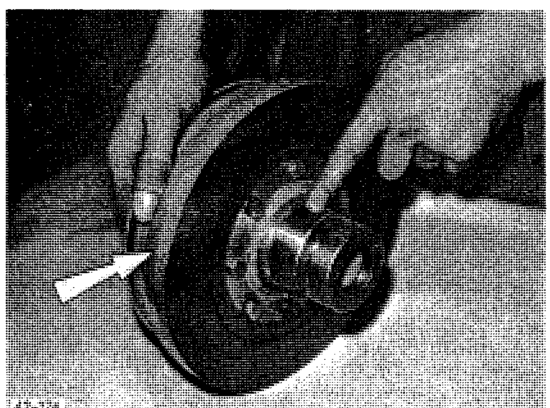


5-27

11. Mount tensioning pulley with shims onto pulley lever.

Note:

For mounting V-belt tensioner onto engine, see Chapter 9/ Page 84.
Fig. 5-27



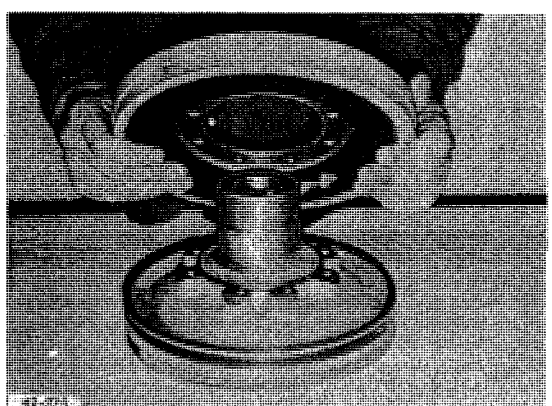
5-28

CHECKING, RENEWING V-BELT PULLEY AND VIBRATION DAMPER

1. Check V-belt pulley and vibration damper.

Note:

Check rubberizing for cracks - see arrow.
Fig. 5-28

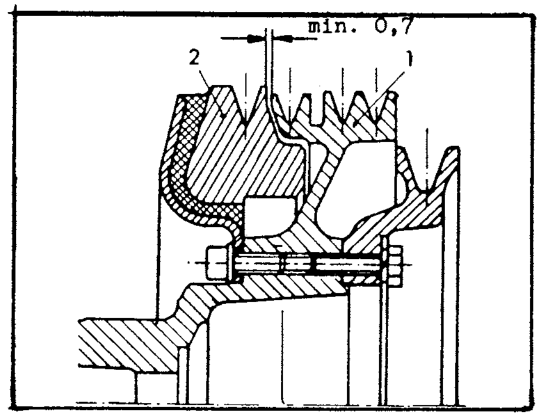


5-29

2. If necessary, separate V-belt pulley from vibration damper by screwing off.
Fig. 5-29

3. On F6L 913 and BF6L 913/C engines:

A gap of 0.7 mm must exist between vibration damper and V-belt pulley.
Fig. 5-30



5-30

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6. Flywheel end

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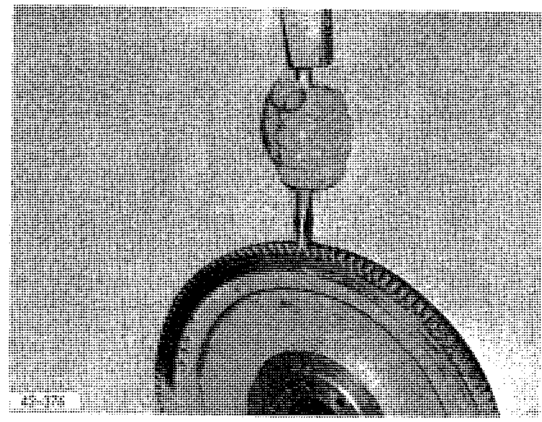
REMOVING, RENEWING STARTER RING GEAR

1. The flywheel is removed. Split damaged starter ring gear and remove.
Fig. 6-1



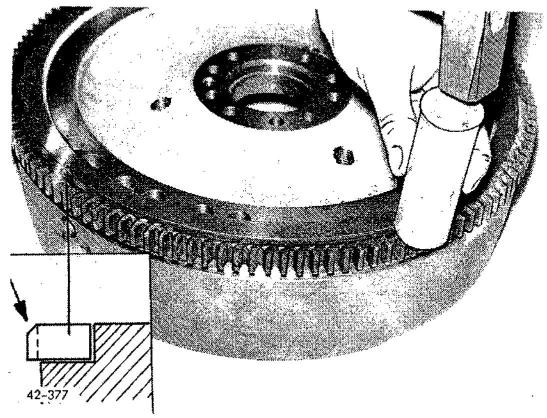
6-1

2. Heat new starter ring gear to 120° C.

Fit on starter ring gear and knock into final position on seating.

Note:

Chamfer of teeth must face away from flywheel.
See sketch.
Fig. 6-2



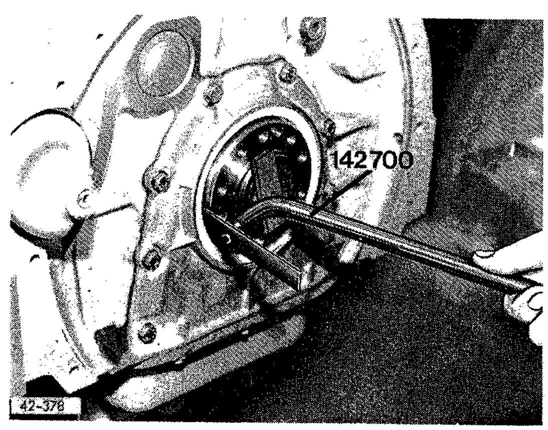
6-2

REMOVING, REFITTING SHAFT SEAL AT FLYWHEEL END

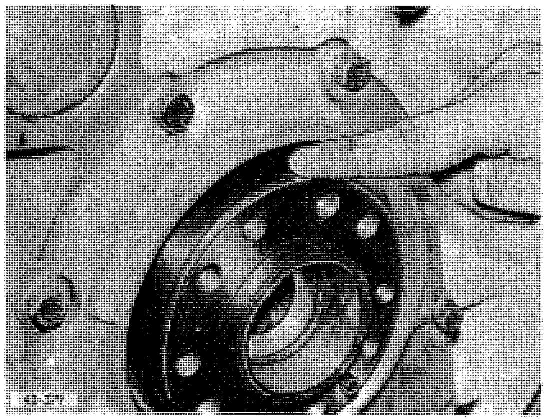
Special tools required:

Extractor .... No. 142700
Fitting device
F2L 912 .... No. 142510
Fitting device
B/F3-6L 912/913 ...... No. 142530

1. Withdraw shaft seal from cover by means of extractor.
Fig. 6-3

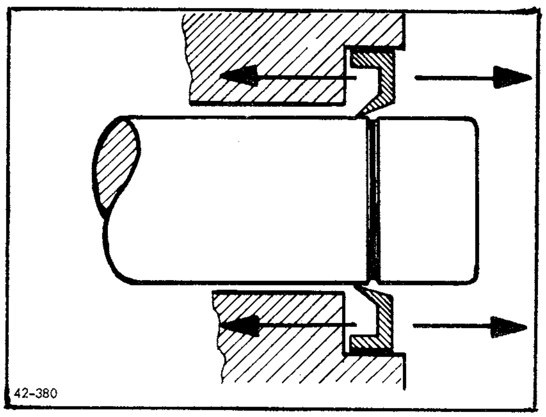


6-3



6-4

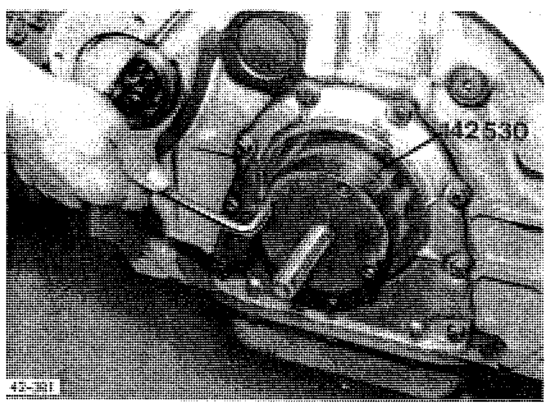
2. Inspect seal contact surface on crankshaft flange for damage. Fig. 6-4



6-5

Note:

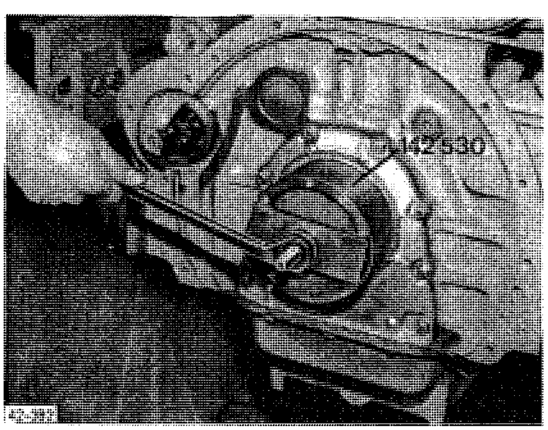
Displace shaft seal axially in case of run-in track. When shifting the shaft seal observe the press-in depth, i.e. until flush on the inside or outside. Max. shifting distance: 1.0 mm Fig. 6-5



6-6

REFITTING as from 3-cyl. engines.

3. Screw guide piece of fitting device onto flange of crankshaft. Fig. 6-6

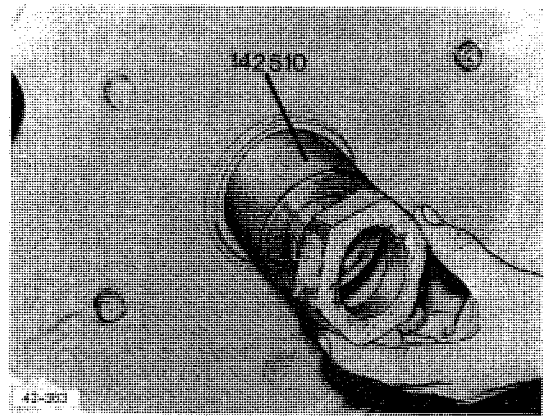


6-7

4. Oil sealing lip of shaft seal. With sealing lip facing towards housing, place seal onto guide piece. Press in with fitting device. Fig. 6-7

REFITTING on 2-cyl. engine

5. Oil sealing lip of shaft seal. With sealing lip facing towards housing, place seal into position. Press in with fitting device.
Fig. 6-8



6-8

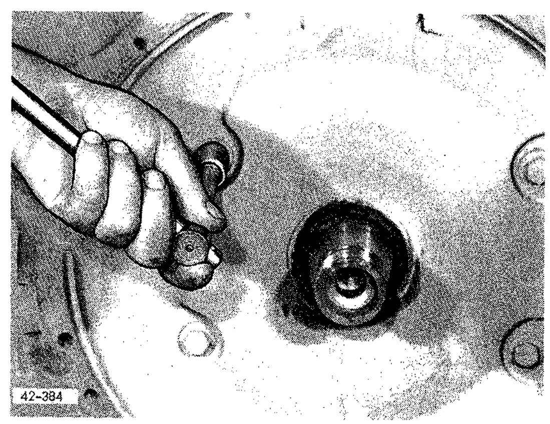
REMOVING, REFITTING AND SEALING ENDSHIELD AT FLYWHEEL END

Special tools required:

Puller .... No. 141000
Fitting device .... No. 141010

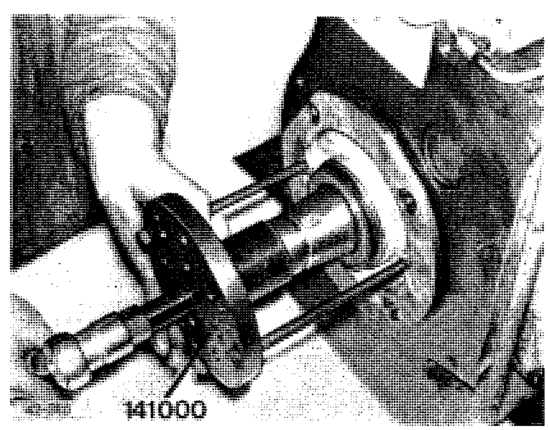
The flywheel is removed.

1. Remove mounting flange.
Fig. 6-9

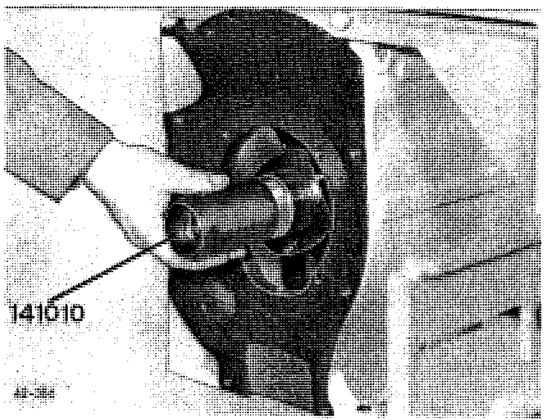


6-9

2. Screw out bolts at endshield and remove endshield by means of puller.
Fig. 6-10

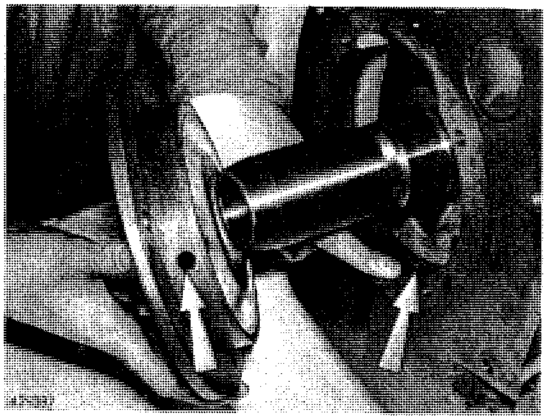


6-10



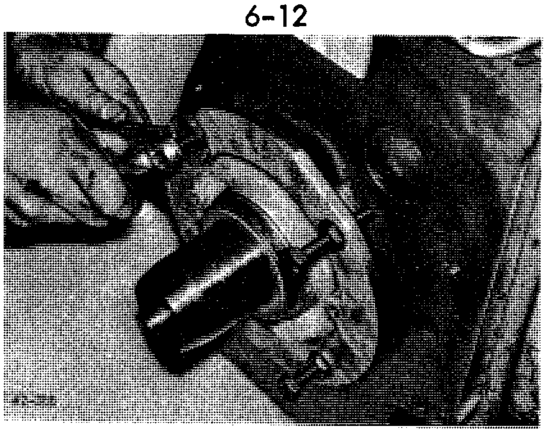
6-11

3. Push bush of fitting device over crankshaft end and apply oil.
Fig. 6-11



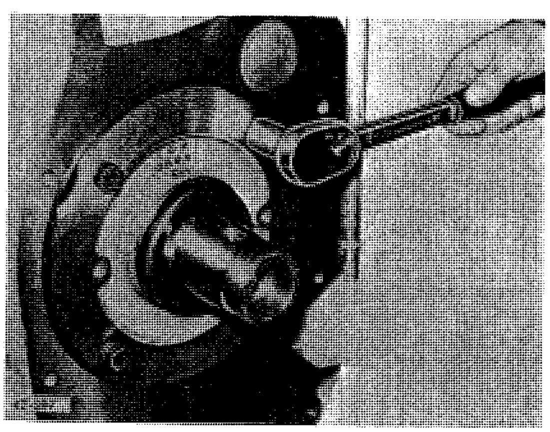
6-12

4. Oil sealing lip of shaft seal. Fit pressembled endshield (see Chapter 4) c/w new gasket. The oil bores of endshield and crankcase must coincide.
Fig. 6-12



6-13

5. Using the fitting device, press in endshield uniformly cross-wise into final position.
Fig. 6-13



6-14

6. Remove fitting device. Insert fastening bolts of endshield c/w washers and tighten uniformly cross-wise.
Fig. 6-14

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7. Injection System

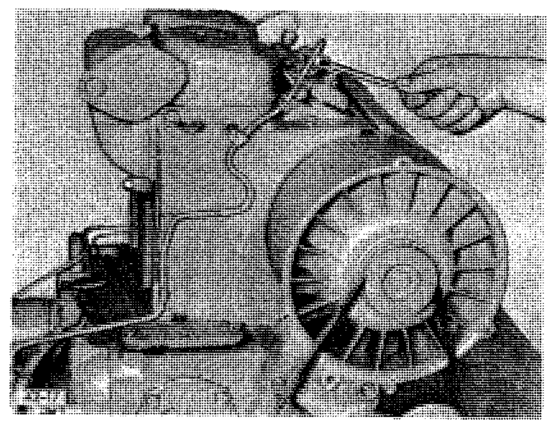
Page

REMOVING AND REFITTING INJECTOR
Direct Injection

Special tools required:

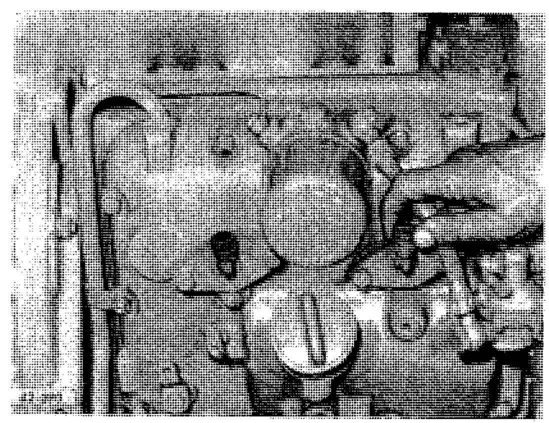
Extractor .... No. 110030
Extractor .... No. 120630
Extractor .... No. 150800

1. Detach injection lines.
Fig. 7-1



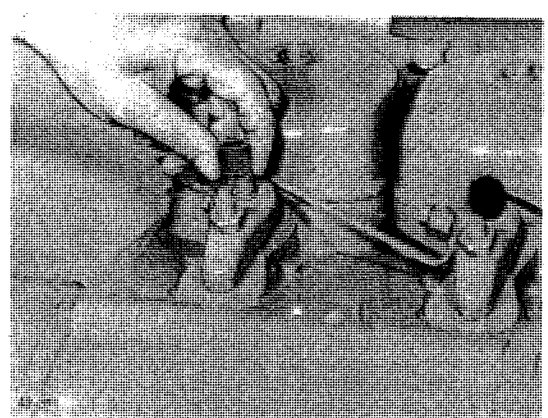
7-1

2. Provide injection line connections at injection pump with protective caps.
Fig. 7-2

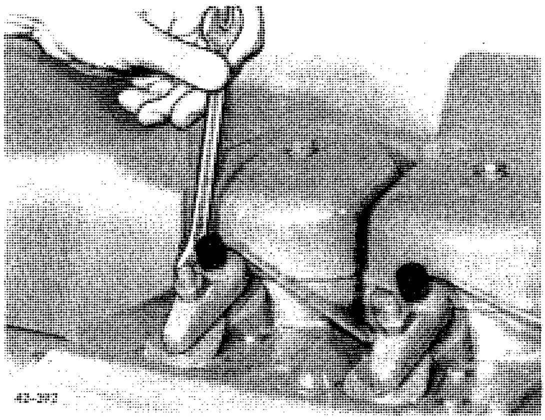


7-2

3. Provide injection line connections at injectors with protective caps.
Fig. 7-3

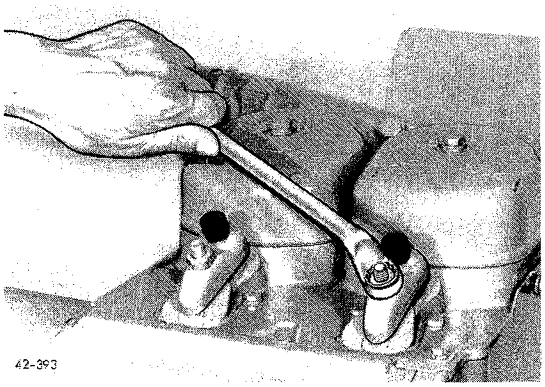


7-3



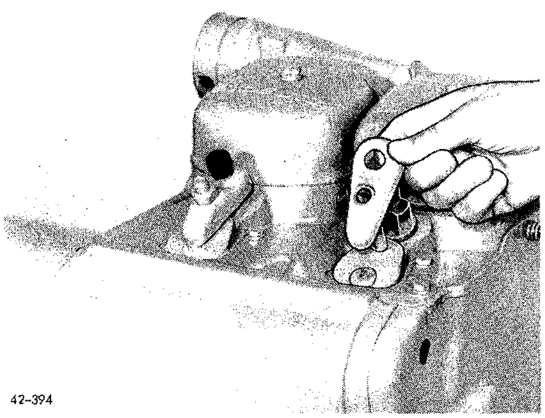
7-4

4. Detach backleakage line.
Fig. 7-4



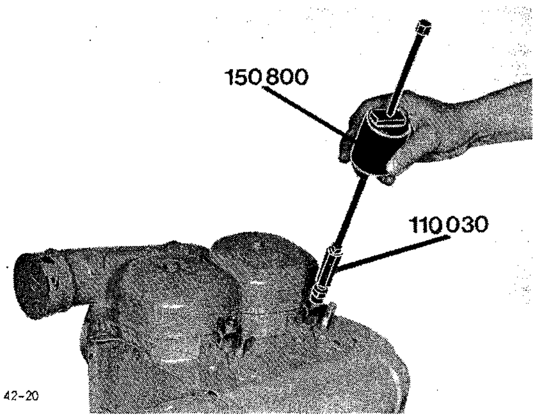
7-5

5. Remove fastening nut.
Fig. 7-5



7-6

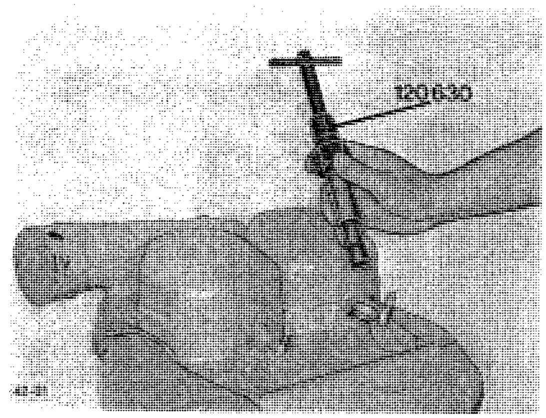
6. Remove clamping bridge.
Fig. 7-6



7-7

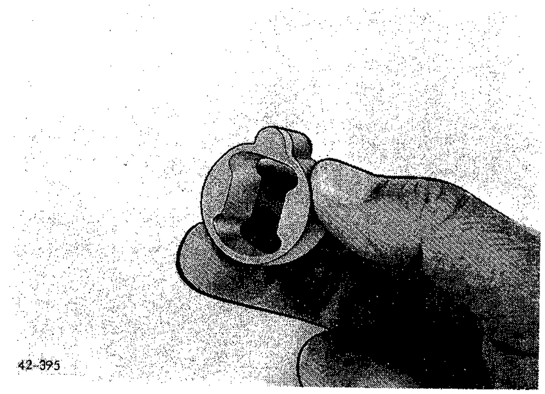
7. Remove injector.
Fig. 7-7

8. Extract special sealing ring.
Fig. 7-8



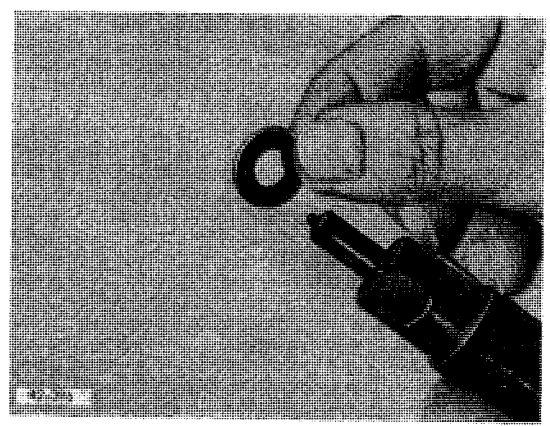
7-8

9. Inspect injector centering piece.
Fig. 7-9



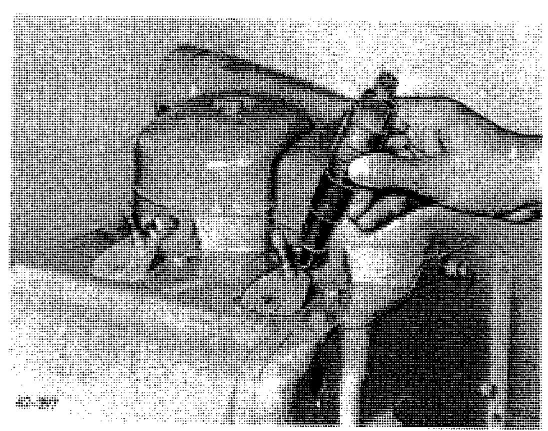
7-9

10. Affix special sealing ring with a little grease on the graphited side onto injector.
Fig. 7-10

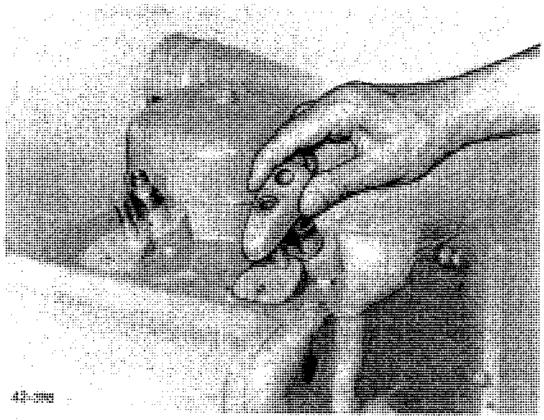


7-10

11. Install injector.
Fig. 7-11

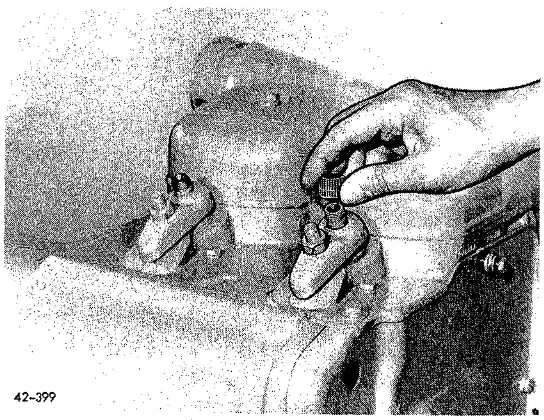


7-11



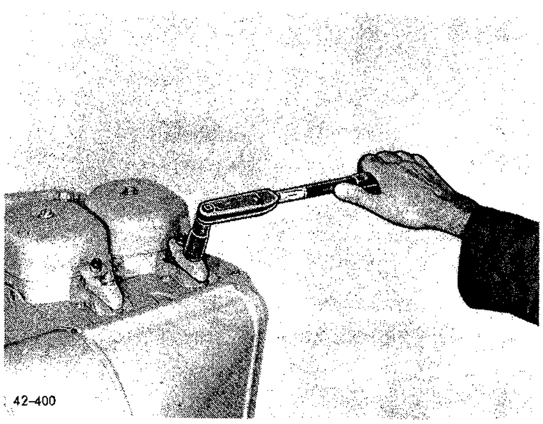
7-12

12. Place clamping bridge in position.
Fig. 7-12



7-13

13. Screw on fastening nuts and caps.
Fig. 7-13



7-14

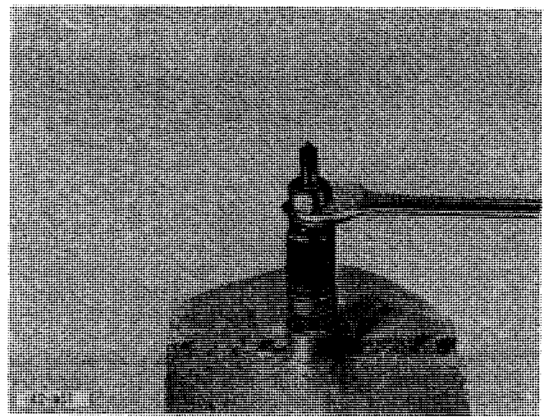
14. Tighten fastening nuts as specified.
Fig. 7-14

910

Removed parts are refitted in reverse order.

DISMANTLING AND REASSEMBLING INJECTOR -
Direct Injection

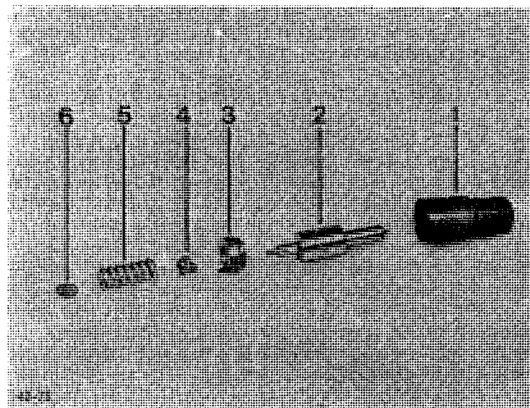
1. Undo cap nut.
Fig. 7-15



7-15

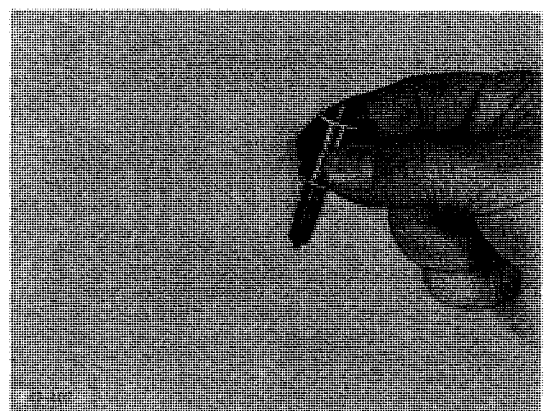
2. Sequence of disassembly

1) Cap nut; 2) Injection nozzle, consisting of nozzle body and nozzle needle; 3) Intermediate piece; 4) Thrust cap; 5) Compression spring; 6) Shims.
Fig. 7-16



7-16

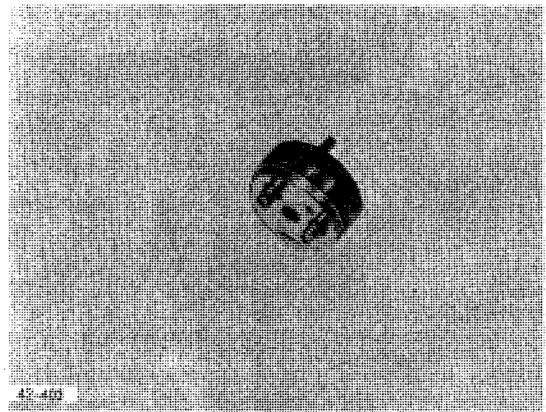
3. Wash components in clean diesel fuel and blow out with compressed air. Nozzle needle and nozzle body are a lapped fit and may not be interchanged or renewed individually. Do not touch the needle with the fingers. When the nozzle body is held vertically, the needle should slide down slowly and smoothly onto its seat under its own weight. If the needle does not slide down smoothly, wash injection nozzle again in diesel fuel. Renew, if necessary.



7-17

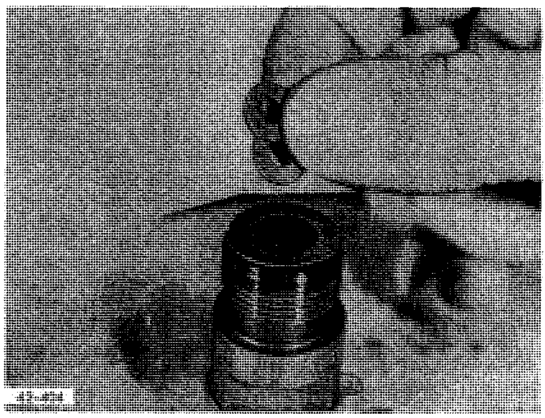
Note:

New injection nozzles must likewise be washed in clean diesel fuel.
Fig. 7-17



7-18

4. Check seating faces of the intermediate piece for wear and the centering pins for firm fit.
Fig. 7-18

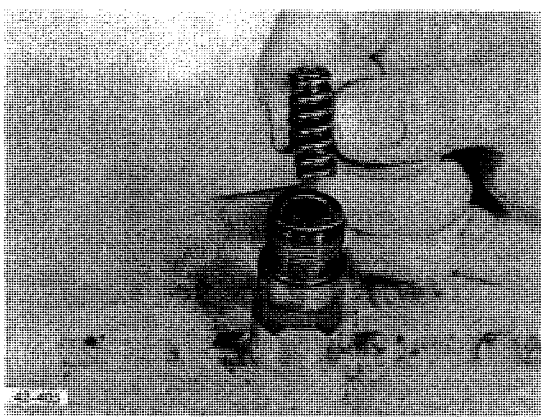


7-19

5. Insert the shims.

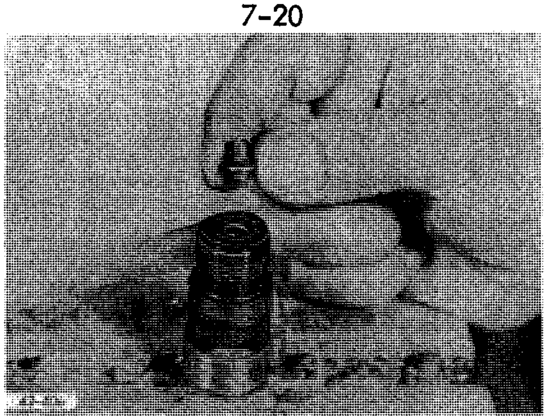
Note:

The opening pressure is dependent on the shims.
TESTING AND ADJUSTING INJECTOR, see Chapter 2.
Fig. 7-19



7-20

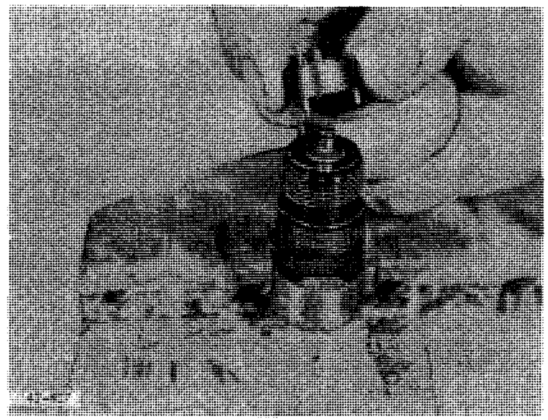
6. Insert compression spring.
Fig. 7-20



7-21

7. Insert thrust cap with the centering collar facing towards the spring.
Fig. 7-21

8. Mount intermediate piece with guide pins fitting into holes in nozzle holder.
Fig. 7-22



7-22

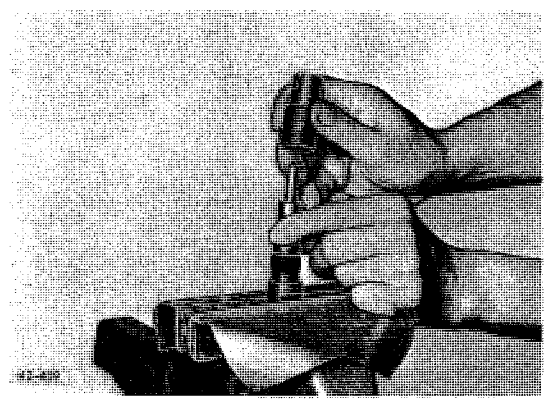
9. Mount injection nozzle with centering holes mating with guide pins of intermediate piece.

Note:

Observe type of nozzle. Take care that nozzle needle does not fall out of nozzle body.
Fig. 7-23

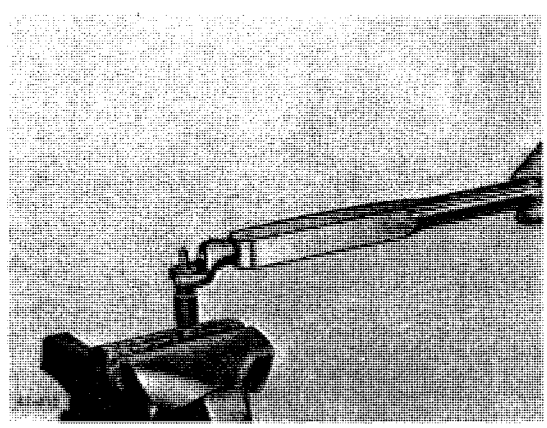
7-23

10. Screw on cap nut.
Fig. 7-24



7-24

11. Tighten cap nut as specified.
Fig. 7-25

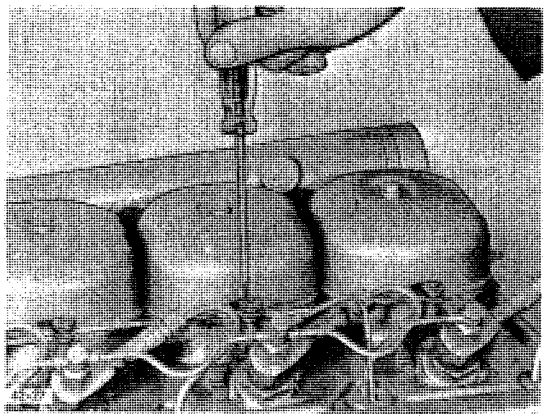


7-25

REMOVING AND REFITTING INJECTOR
Two-stage Combustion

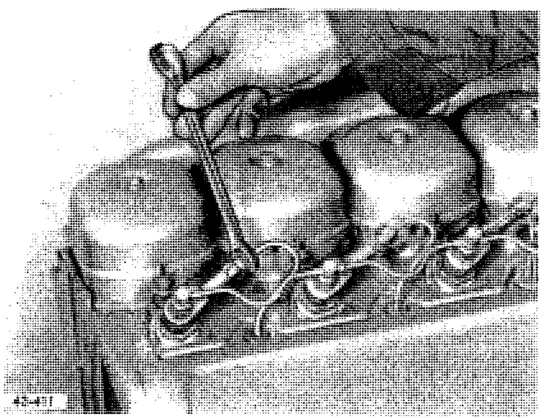
Special tools required:

Screw fitting .... No. 110050
Extractor .... No. 150800



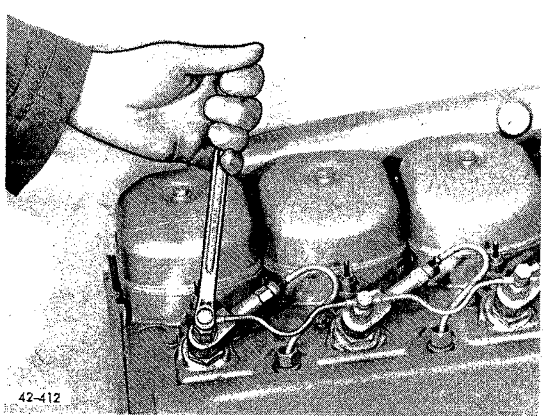
7-26

1. Detach electrical cable and contact rails.
Fig. 7-26



7-27

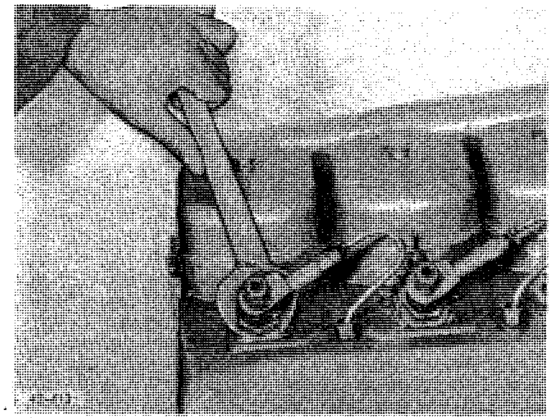
2. Detach injection line.
Fig. 7-27



7-28

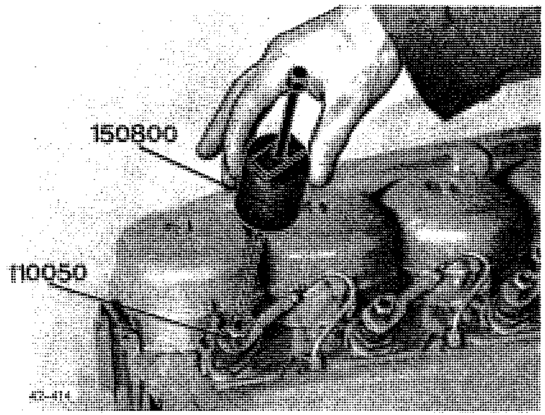
3. Detach backleakage line.
Fig. 7-28

4. Remove cap screw securing injector.
Fig. 7-29



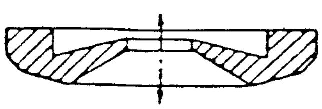
7-29

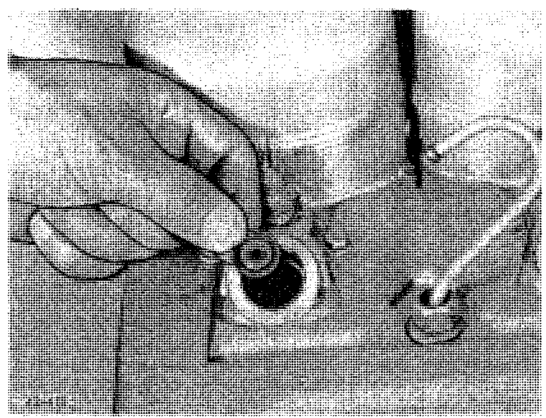
5. o Screw on screw fitting.
   o Using extractor, remove injector.
   o Take out heat shield plate.
Fig. 7-30



7-30

6. Insert new heat shield plate in cylinder head the correct way round. See sketch.
Fig. 7-31

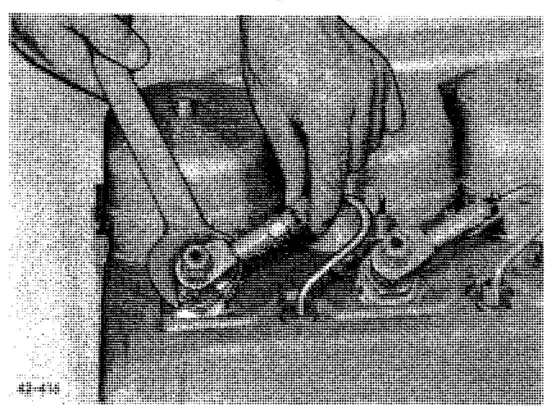




7-31

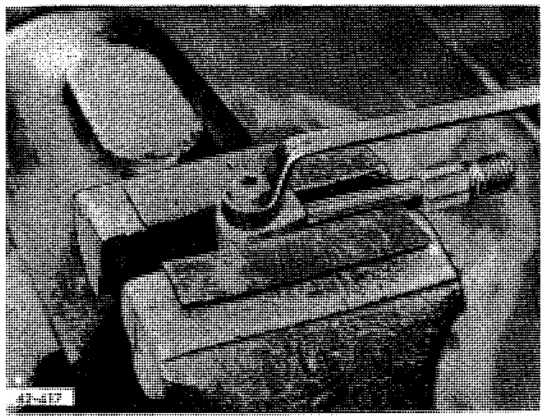
7. Insert injector, align to injection line, and tighten.
Fig. 7-32

Refit removed parts in reverse order.



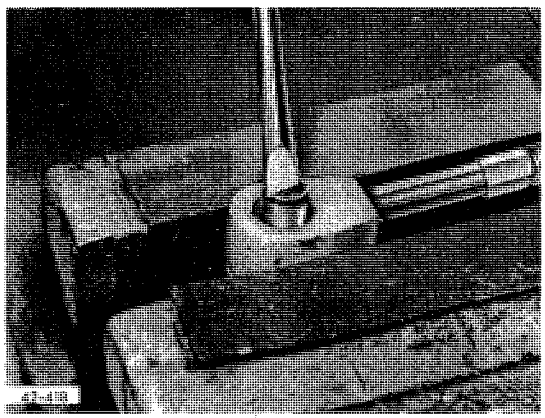
7-32

DISMANTLING AND REASSEMBLING INJECTOR
Two-stage Combustion



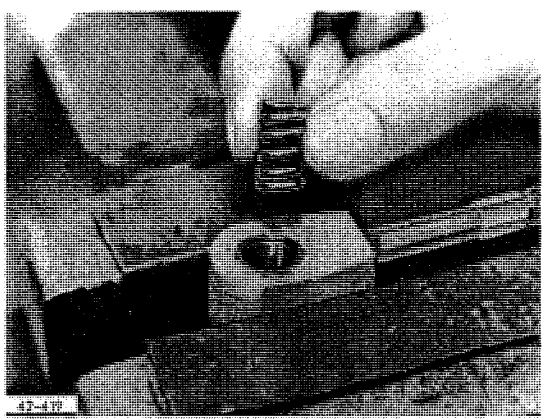
7-33

1. Remove cap.
Fig. 7-33



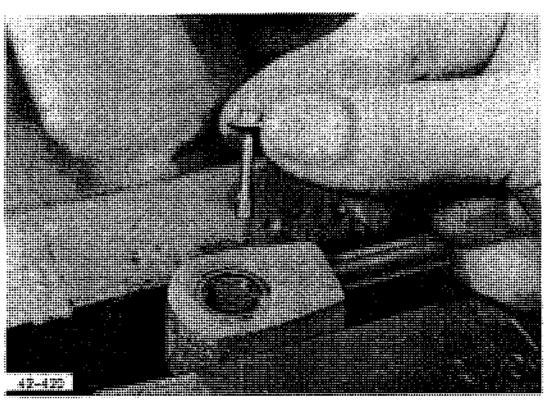
7-34

2. Remove adjusting screw.
Fig. 7-34



7-35

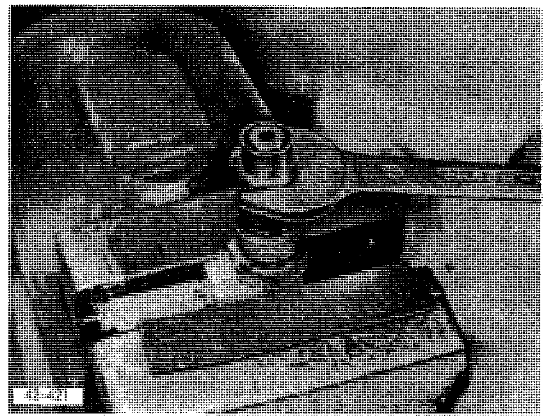
3. Take out compression spring.
Fig. 7-35



7-36

4. Take out spindle.
Fig. 7-36

5. Undo cap nut.
Fig. 7-37

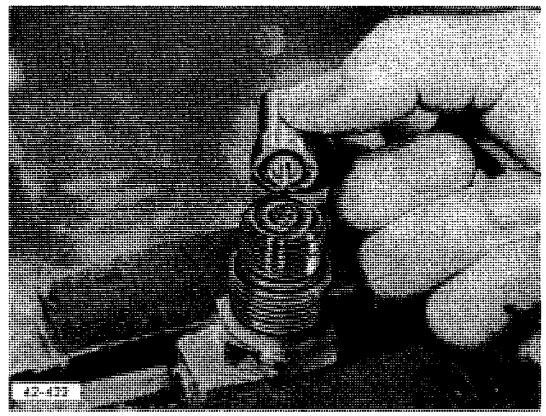


7-37

6. Take off injection nozzle complete.
Fig. 7-38

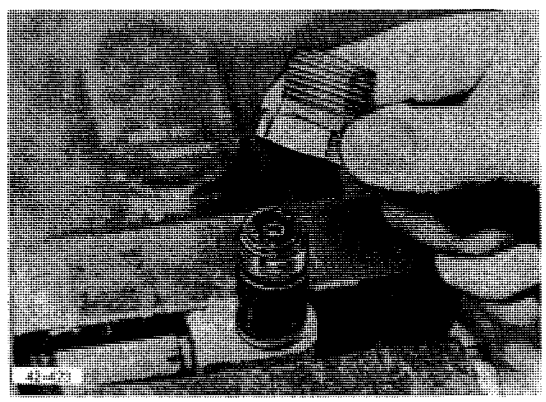
Note:

Take care that nozzle needle does not fall out of nozzle body.
Fig. 7-38



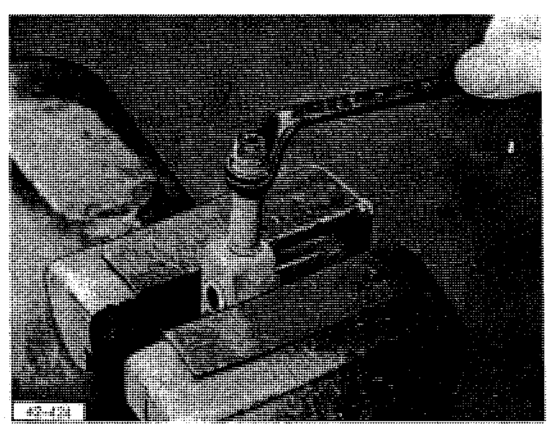
7-38

7. Remove cap screw.
Fig. 7-39

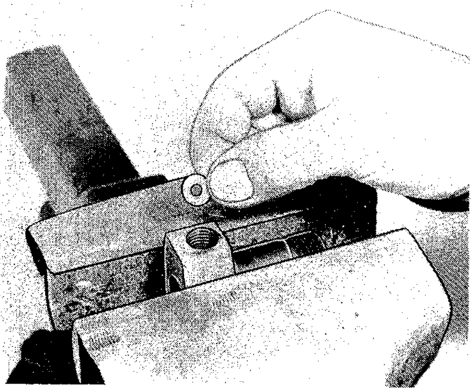


7-39

8. Screw out pressure pipe.
Fig. 7-40



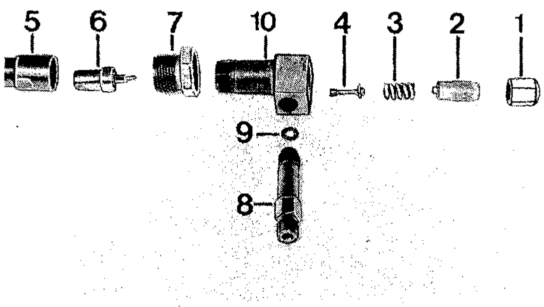
7-40



42-425

7-41

9. Remove sealing washer for pressure pipe.
Fig. 7-41

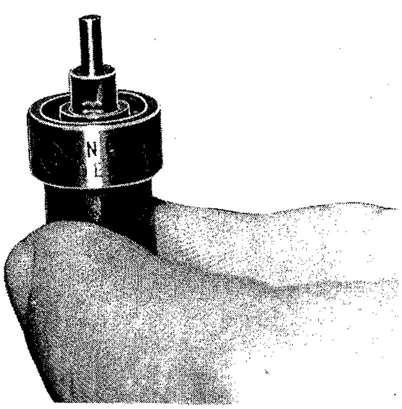


42-426

7-42

Sequence of disassembly of nozzle holder, (10):

1) Cap; 2) Adjusting screw; 3) Compression spring; 4) Spindle; 5) Cap nut; 6) Injection nozzle, consisting of nozzle body with nozzle needle; 7) Cap screw; 8) Pressure pipe; 9) Sealing washer.
Fig. 7-42



42-427

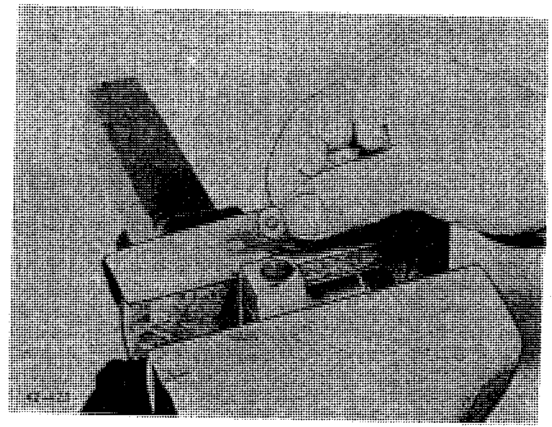
7-43

10. Wash components in clean diesel fuel and blow out with compressed air. Nozzle needle and nozzle body are a lapped fit and may not be interchanged or renewed individually. Do not touch needle with fingers. When nozzle body is held vertically, the needle should slide down slowly and smoothly onto its seat under its own weight. If needle does not slide down smoothly, wash injection nozzle again in diesel fuel. Renewe, if necessary.

Note:

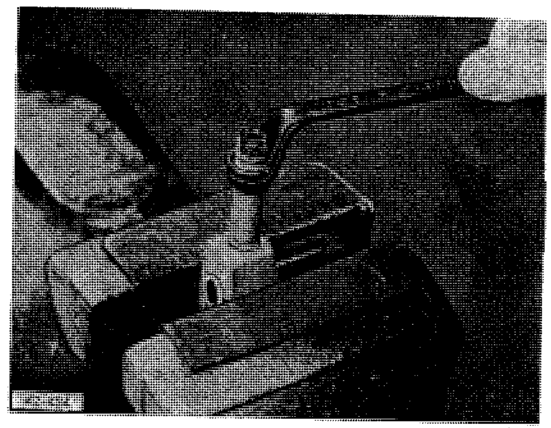
New injection nozzle must likewise be washed in clean diesel fuel.
Fig. 7-43

11. Insert sealing washer for pressure pipe.
Fig. 7-44



7-44

12. Insert pressure pipe.
Fig. 7-45



7-45

13. Fit cap screw.
Fig. 7-46

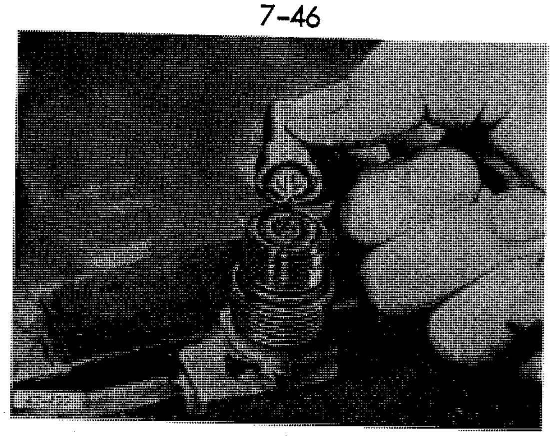
7-46

14. Mount injection nozzle.

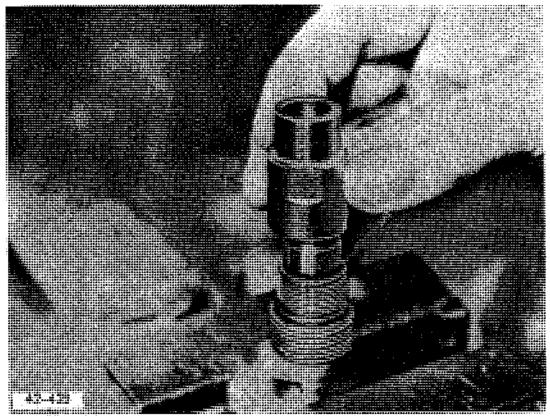
Note:

Observe type of nozzle. Take care that nozzle needle does not fall out of nozzle body.
Fig. 7-47

131

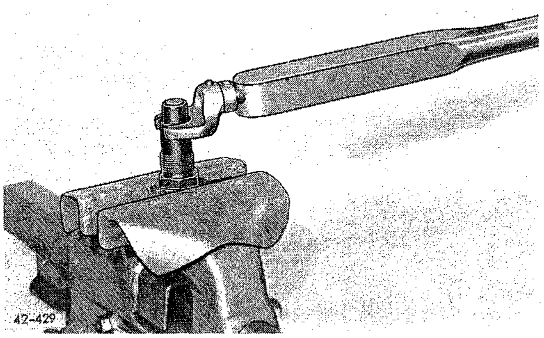


7-47



7-48

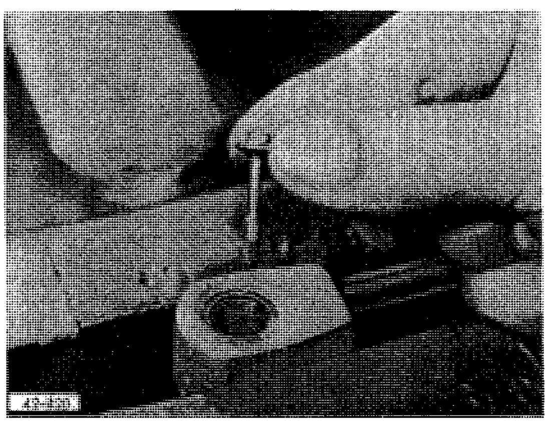
17. Screw on cap nut.
Fig. 7-48



7-49

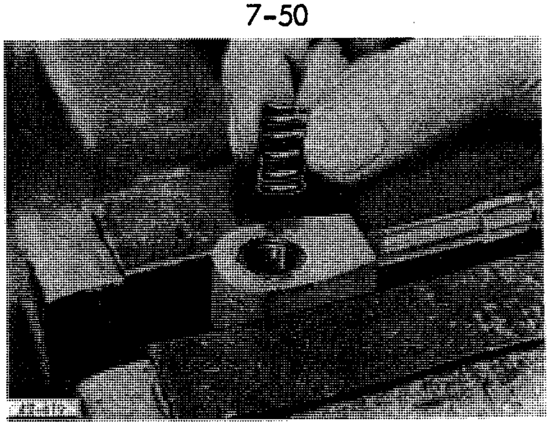
18. Tighten cap nut as specified.
Fig. 7-49

914



7-50

19. Insert spindle.
Fig. 7-50



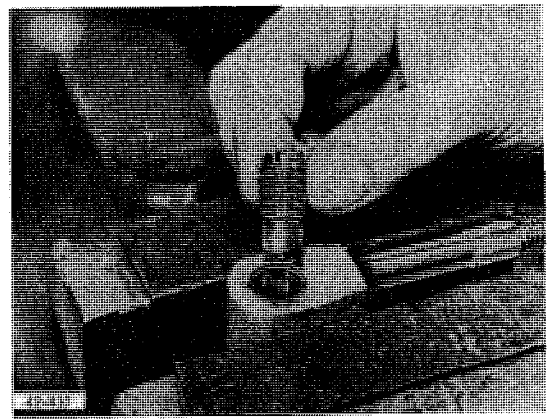
7-51

20. Insert compression spring.
Fig. 7-51

21. Screw in adjusting screw.

Note:

Turning in adjusting screw increases opening pressure, turning out decreases opening pressure.
See Chapter 2.
Fig. 7-52

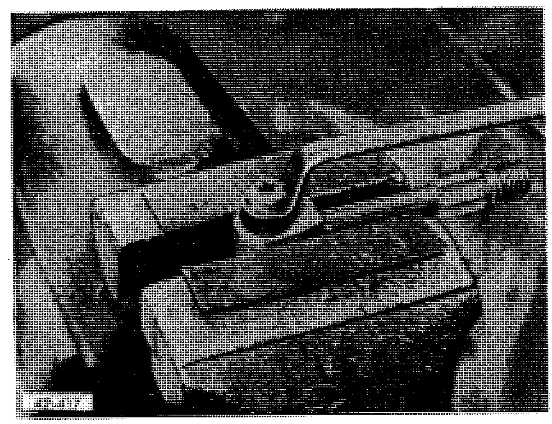


7-52

22. Screw on cap by hand.

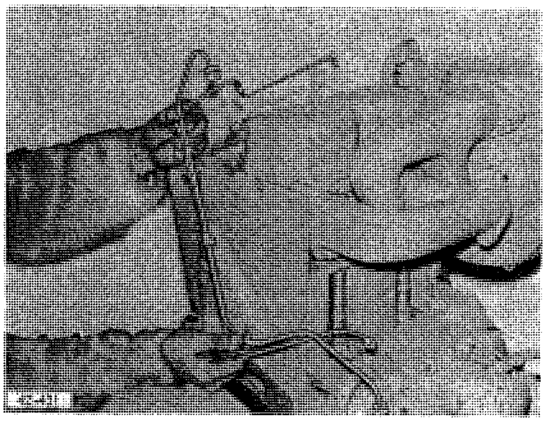
Note:

Cap will be tightened after testing after adjusting the injector.
See Chapter 2.
Fig. 7-53

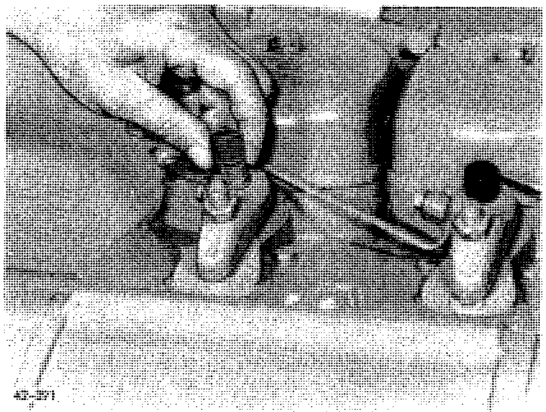


7-53

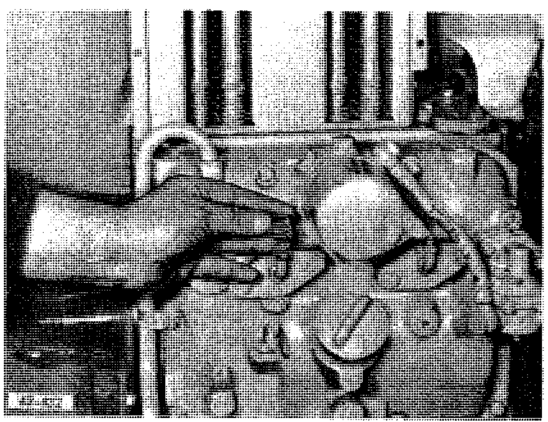
REMOVING AND REFITTING DEUTZ INJECTION PUMP - F2L 912 -


7-54

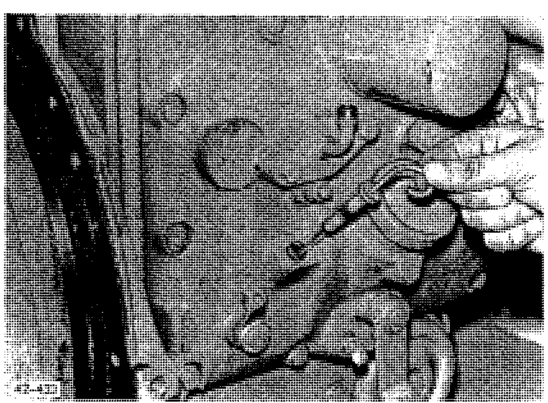
1. Remove injection lines and backleakage line.
Fig. 7-54


7-55

2. Provide injection line connections at injectors with protective caps.
Fig. 7-55

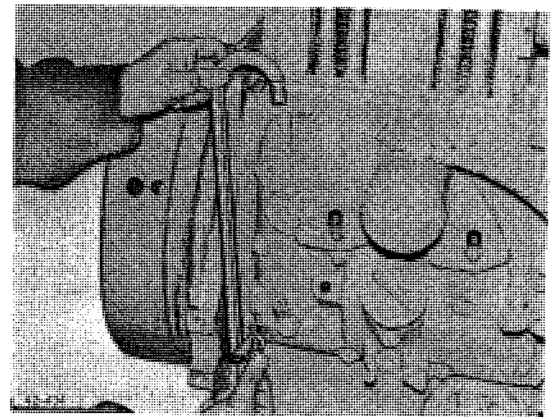

7-56

3. Provide injection line connections at injection pump with protective caps.
Fig. 7-56

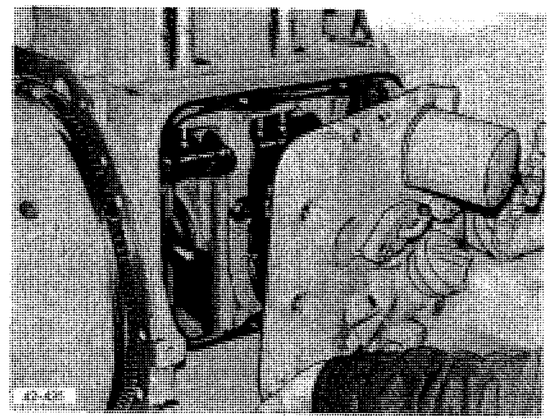

7-57

4. Take out oil dipstick.
Fig. 7-57

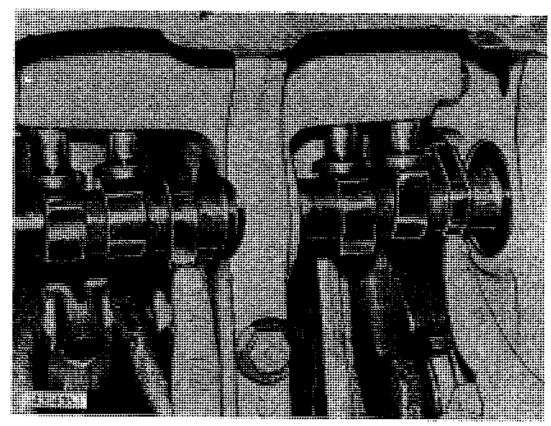
5. Remove crankcase breather pipe.
Fig. 7-58


7-58

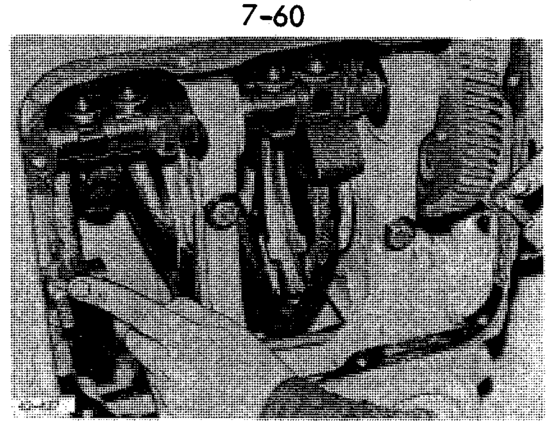
6. Loosen bolts cross-wise. Take off injection pump cover and gasket.
Fig. 7-59

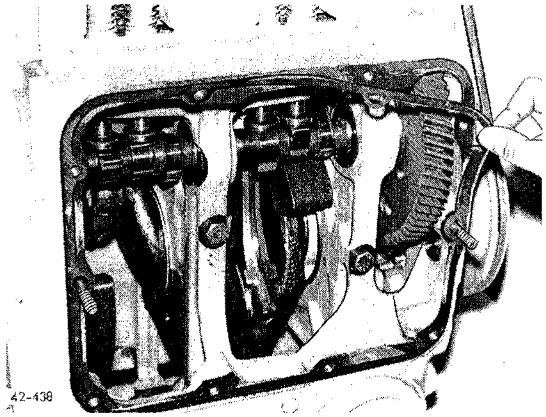

7-59

7. Turn crankshaft so that cams for injection pump elements point towards crankcase.
Fig. 7-60


7-60

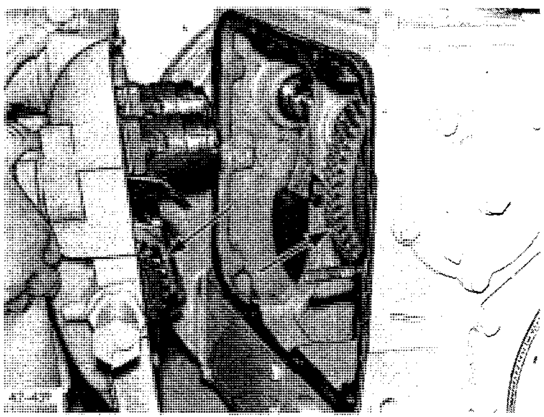
8. Check pressure of dowel sleeves.
Fig. 7-61


7-61



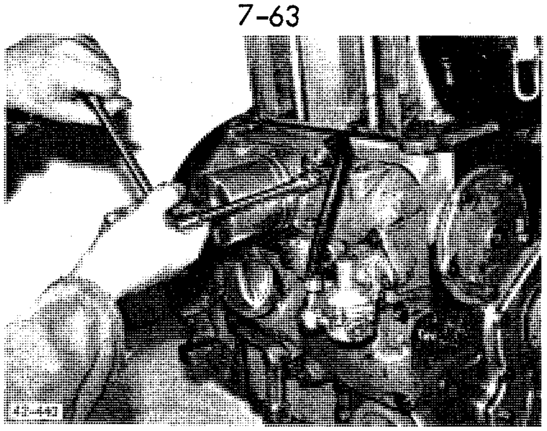
7-62

9. Affix gasket to crankcase.
Fig. 7-62



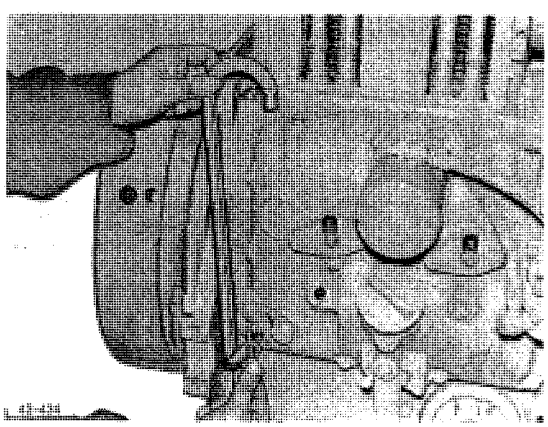
7-63

10. Place on injection pump, making sure that the gears engage.
Fig. 7-63



7-64

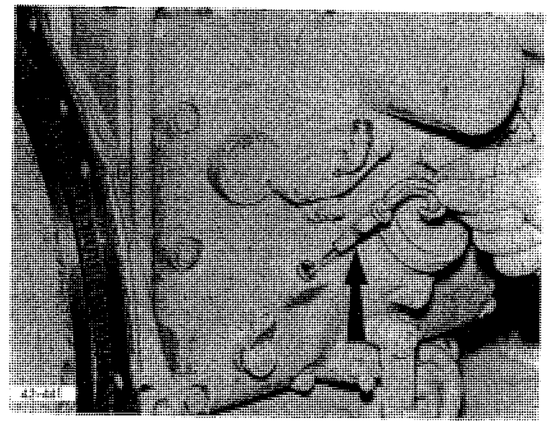
11. Tighten fastening bolts cross-wise.
Fig. 7-64



7-65

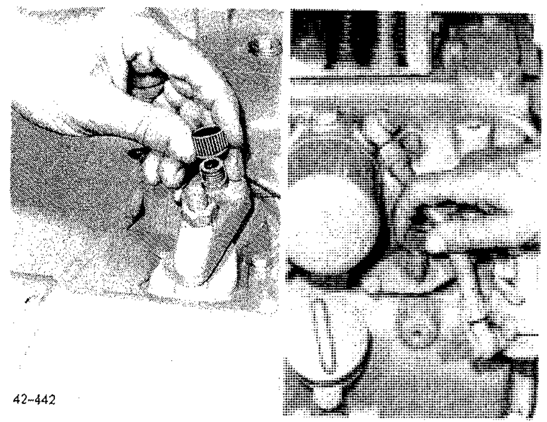
12. Insert crankcase breather pipe with Deutz DW 50 sealing compound.
Fig. 7-65

13. Insert oil dipstick c/w new O-seal.
Fig. 7-66



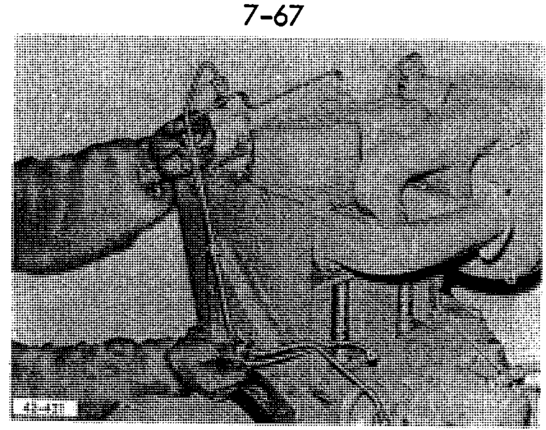
7-66

14. Remove protective caps from injection line connections at injectors (photo, left).
Remove protective caps from injection line connections at injection pumpe (photo, right).
Fig. 7-67



7-67

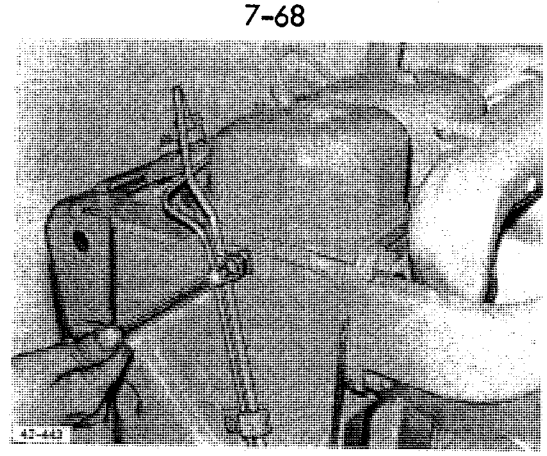
15. Mount injection lines and backleakage line.
Fig. 7-68



7-68

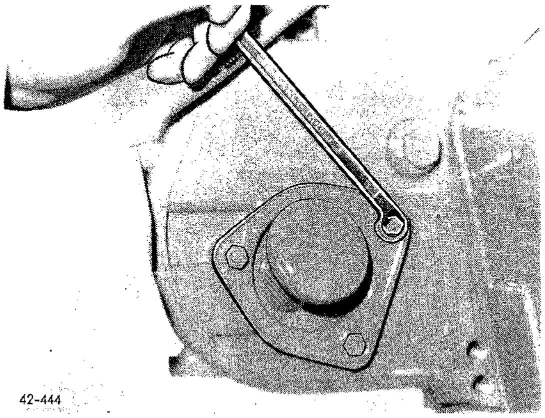
16. Fasten lnes with clips.
Fig. 7-69

Adjust beginning of delivery. Chapter 2: Checking and Adjusting.



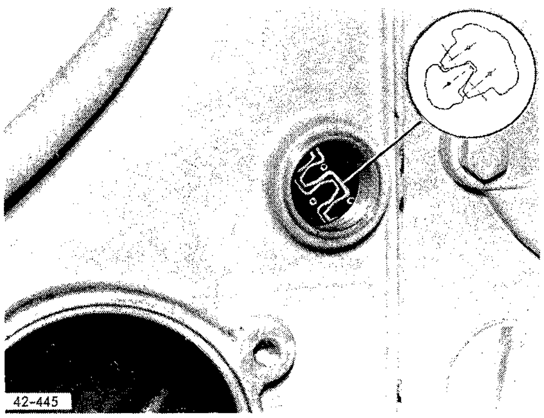
7-69

REMOVING AND REFITTING BOSCH INJECTION PUMP - F2L 912 -



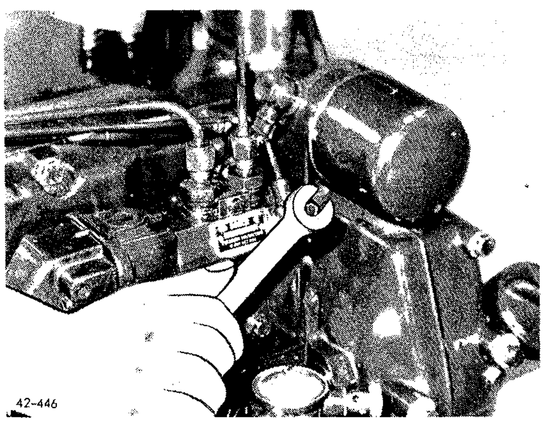
7-70

1. Remove cover.
Fig. 7-70



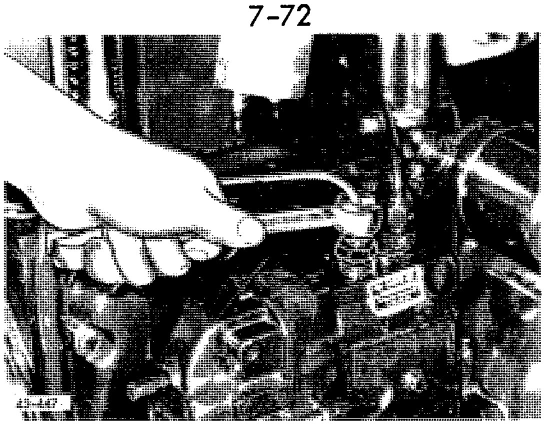
7-71

2. Screw out plug. Turn crankshaft until punch marks on gears coincide.
Fig. 7-71



7-72

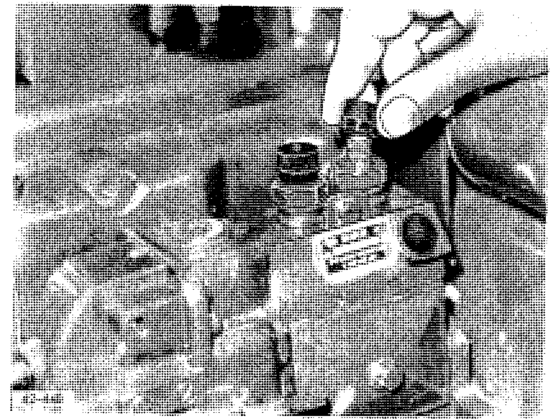
3. Detach backleakage line.
Fig. 7-72



7-73

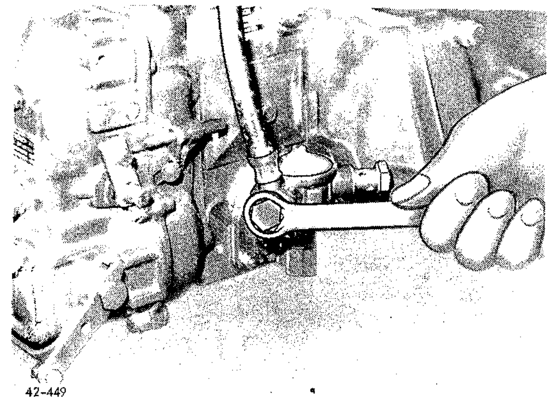
4. Detach injection lines.
Fig. 7-73

5. Close connections for injection lines with protective caps.
Fig. 7-74



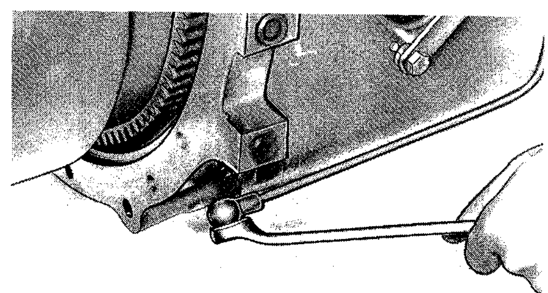
7-74

6. Remove fuel lines.
Fig. 7-75



7-75

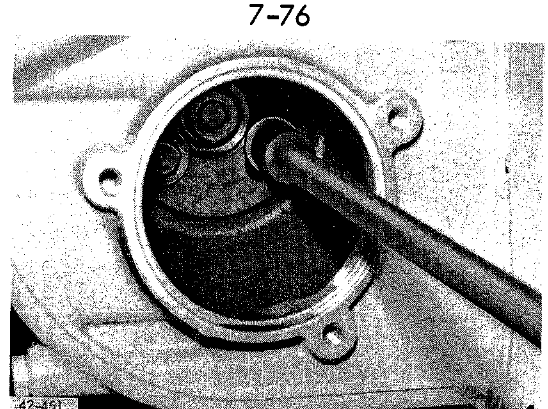
7. Remove lube oil line from injection pump to crankcase.
Fig. 7-76



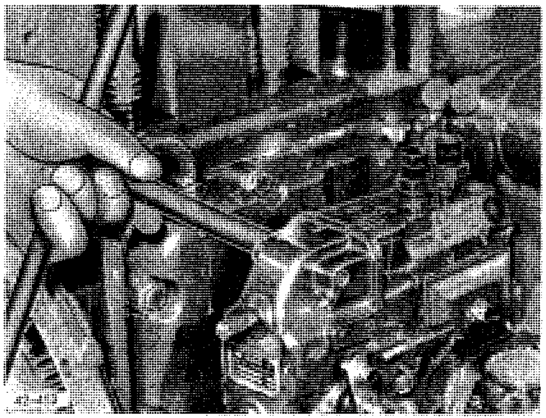
42-450

7-76

8. Screw out fastening bolts for drive gear.
Fig. 7-77



7-77

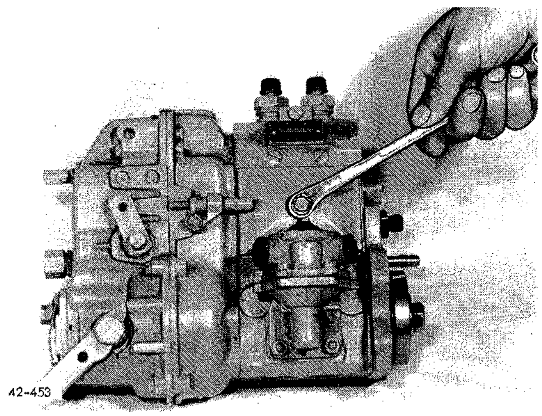


7-78

9. Screw off nuts fastening injection pump. Take off pump.
Fig. 7-78

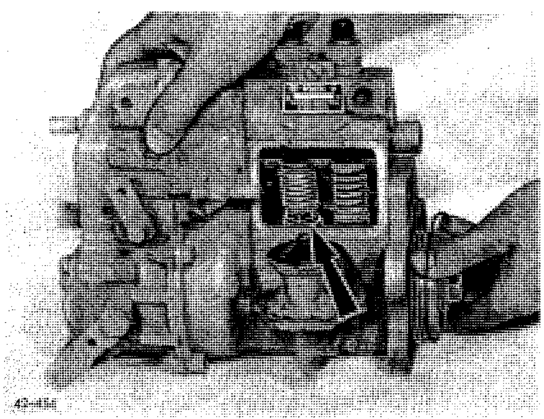
Note:

Do not turn engine further.



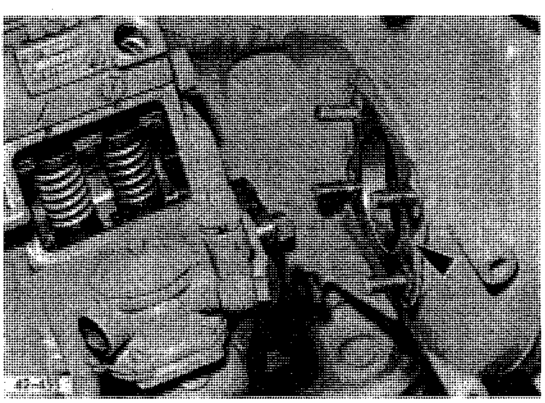
7-79

10. Remove cover of injection pump.
Fig. 7-79



7-80

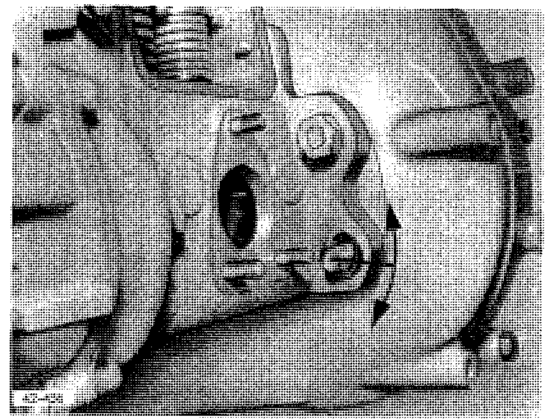
11. Turn camshaft of injection pump until 1st plunger lifts.
Fig. 7-80



12. Place gasket on flange and fit pump in position.
Fig. 7-81

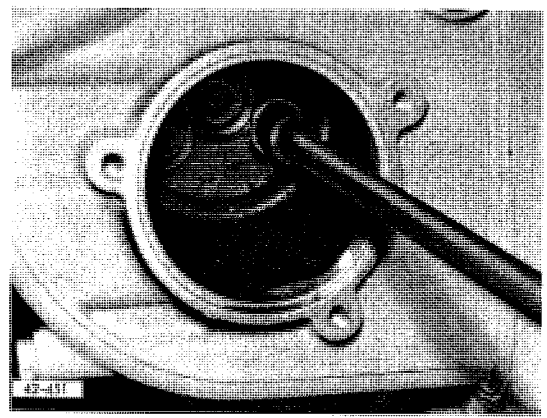
7-81

13. Adjust elongated holes to middle position. Tighten pump fastening nuts.
Fig. 7-82



7-82

14. Insert fastening bolts for drive gear and tighten.
Fig. 7-83



7-83

Refit removed parts in reverse order.

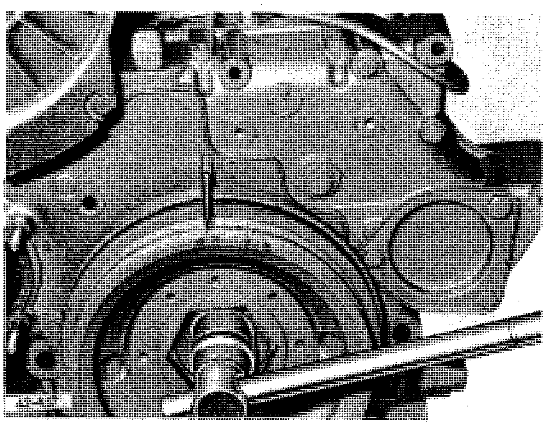
Adjust beginning of delivery, see Chapter 2: Checking and Adjusting.

REMOVING AND REFITTING BOSCH INJECTION PUMP
- as from 3-cyl. engine -

The V-belt tensioner or cover is removed.

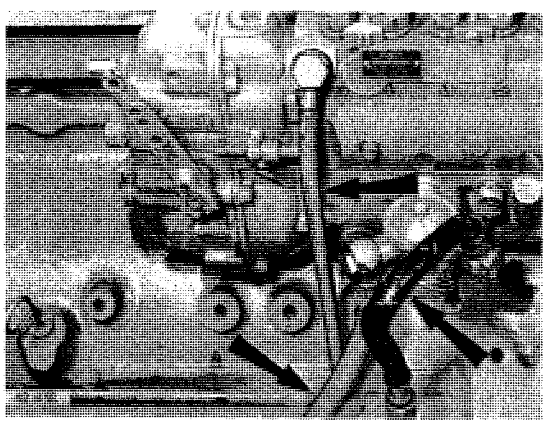
Special tools required:

Special spanner ...... No. 110310
Device .... No. 110340



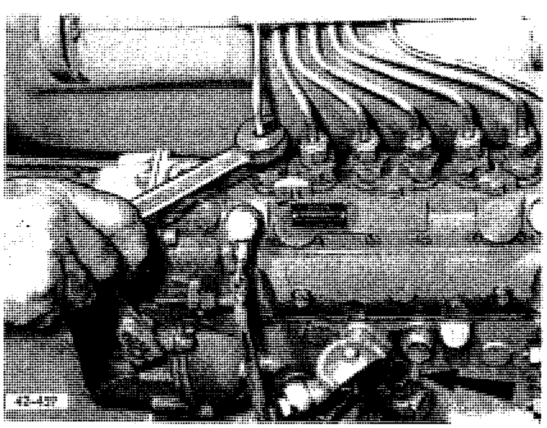
7-84

1. Set cylinder No. 1 to ignition TDC position.
Fig. 7-84



7-85

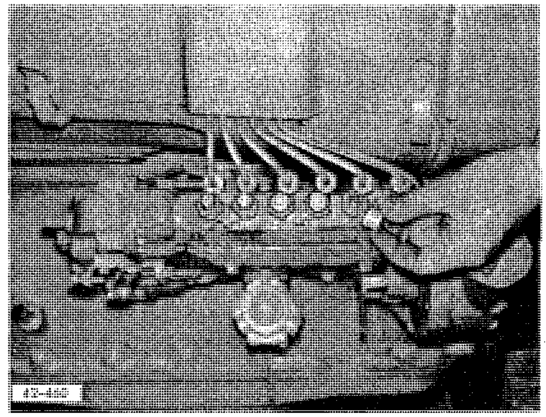
2. Detach fuel lines/hoses.
Fig. 7-85



7-86

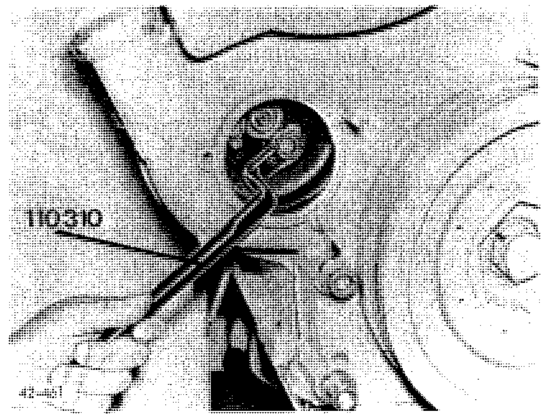
3. Detach injection lines and lube oil line (arrow).
Fig. 7-86

4. Close injection line connections at injection pump with protective caps.
Fig. 7-87



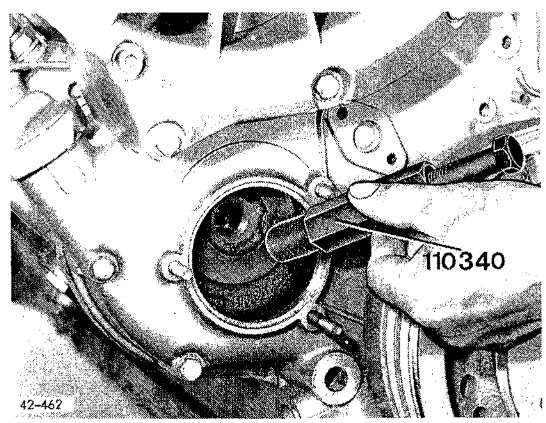
7-87

5. Injection pump drive without advance/retard unit:
Screw out fastening bolts for rigid drive gear at the hub.
Fig. 7-88



7-88

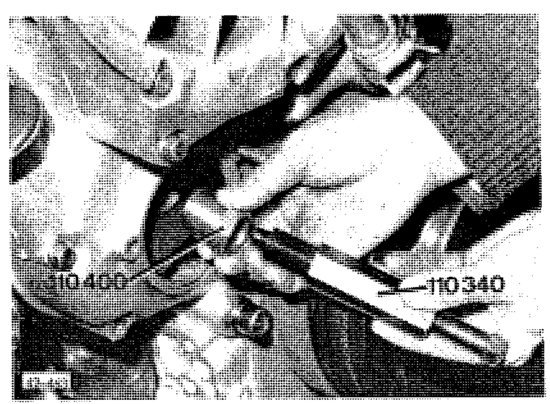
6. Injection pump drive with advance/retard unit:
6.1. Bosch "A" injection pump. Undo clamping nut of injection pump camshaft and pull off advance/retard unit with device.
Fig. 7-89



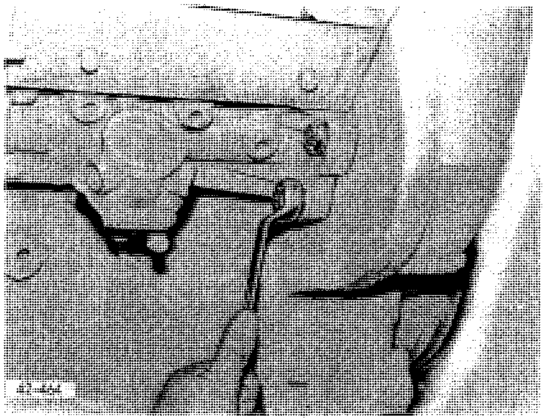
7-89

6.2. Bosch "MW" injection pump.
- o Undo clamping nut of injection pump camshaft.
- o Screw in bush of device.
- o Pull off advance/retard unit with device.

Fig. 7-90

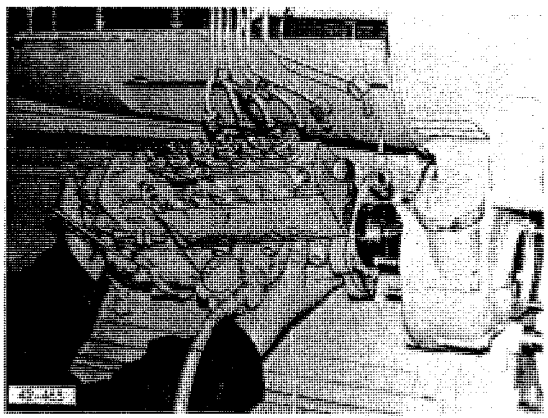


7-90



7-91

7. Remove fastening nuts at flange.
Fig. 7-91

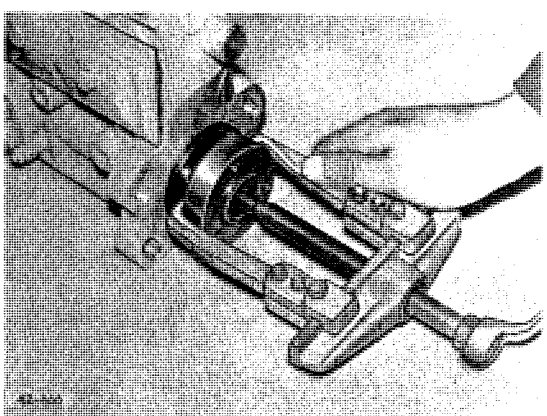


7-92

8. Take off injection pump.

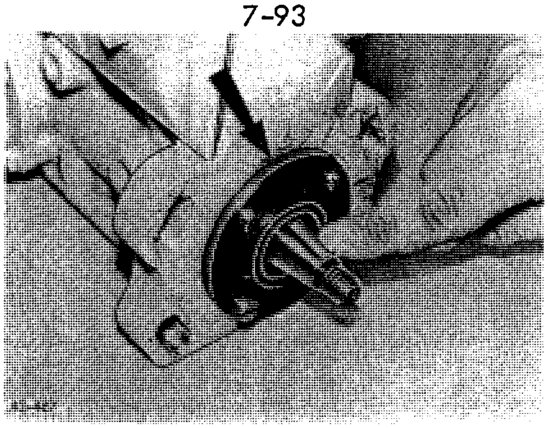
Note:

Do not turn engine further.
Fig. 7-92



7-93

9. Unscrew fastening nuts and pull off hub from camshaft.
Fig. 7-93



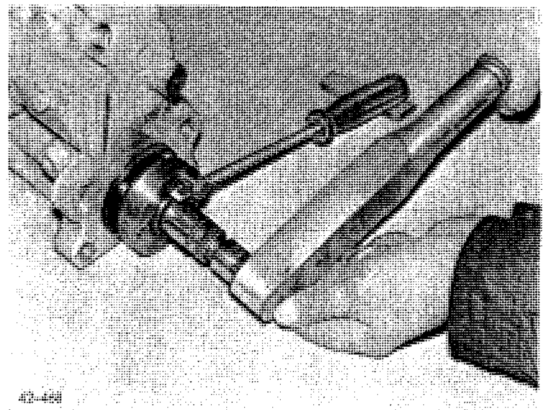
7-94

REFITTING: Without advance/retard unit.

10. Insert Woodruff key. Place on new O-seal (see arrow).
Fig. 7-94

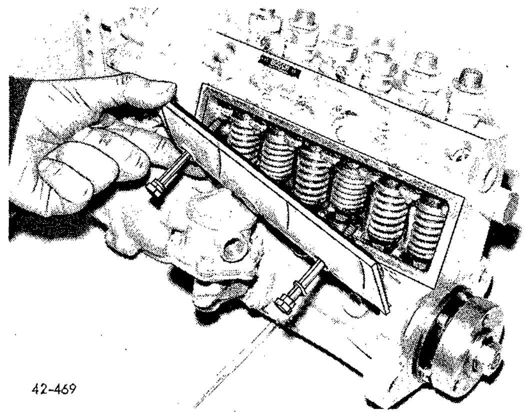
11. Push on hub and tighten nut as specified.
Fig. 7-95

912



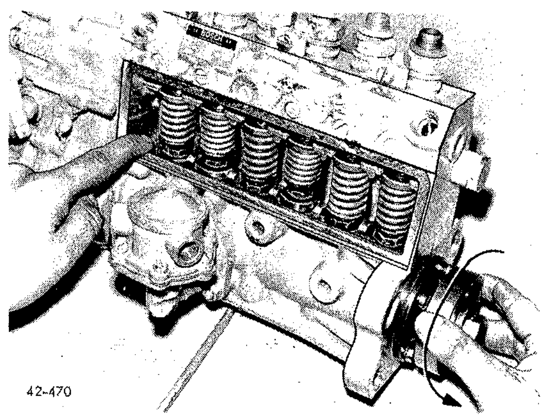
7-95

12. Remove cover of injection pump.
Fig. 7-96



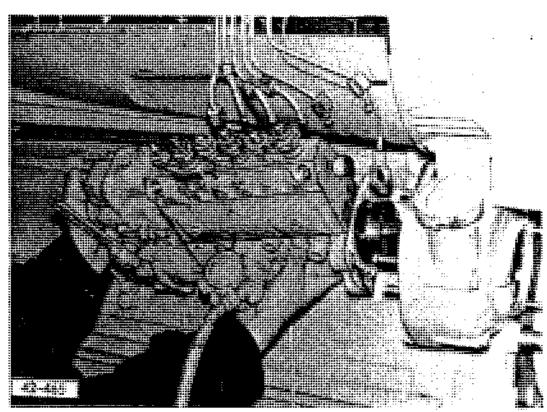
7-96

13. Turn camshaft of injection pump until plunger cyl. No. I lifts. Refit pump cover.
Fig. 9-97

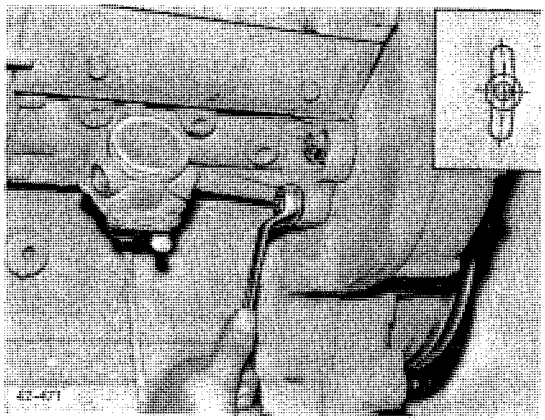


7-97

14. Mount injection pump.
Fig. 7-98

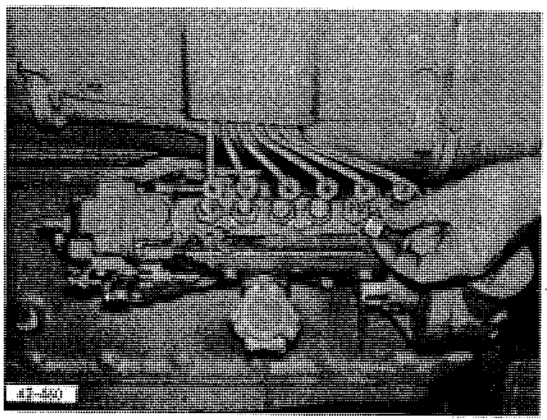


7-98



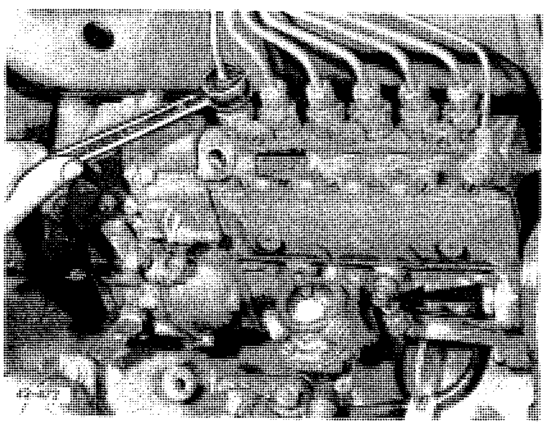
7-99

15. Adjust elongated holes to middle position. Tighten pump fastening nuts.
Fig. 7-99



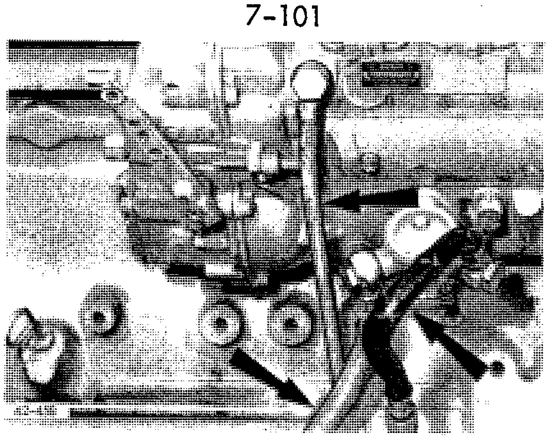
7-100

16. Remove protective caps.
Fig. 7-100



7-101

17. Mount injection lines and lube oil line.
Fig. 7-101



7-102

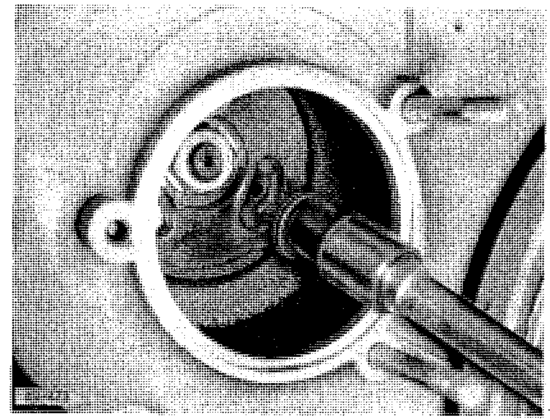
18. Mount fuel lines/hoses.
Fig. 7-102

19. Insert fastening bolts for gear and tighten.

Note:

Adjust beginning of delivery, see Chapter 2.
Fig. 7-103

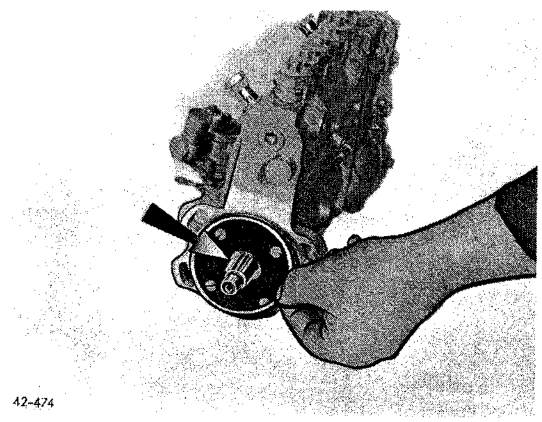
Refit removed parts in reverse order.



7-103

REFITTING: With advance/retard unit.

20. Insert Woodruff key. Place on new O-seal.
Fig. 7-104

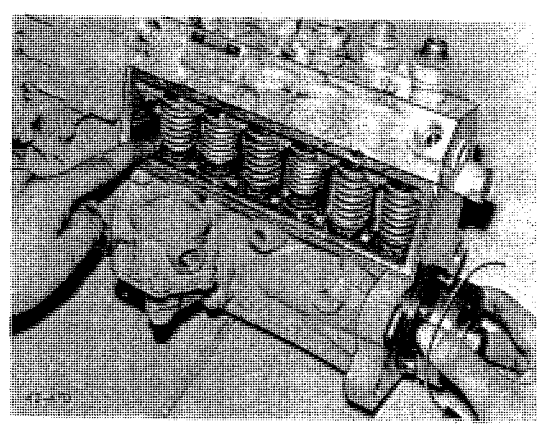


7-104

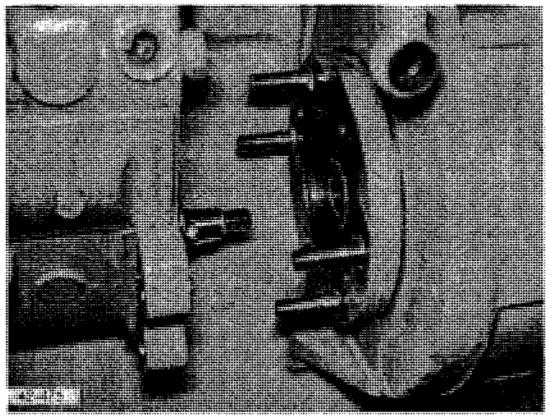
21. Turn camshaft of injection pump until plunger cyl. No. 1 lifts. Refit pump cover.

Note:

Use suitable aid for turning at camshaft cone.
Fig. 7-105



7-105

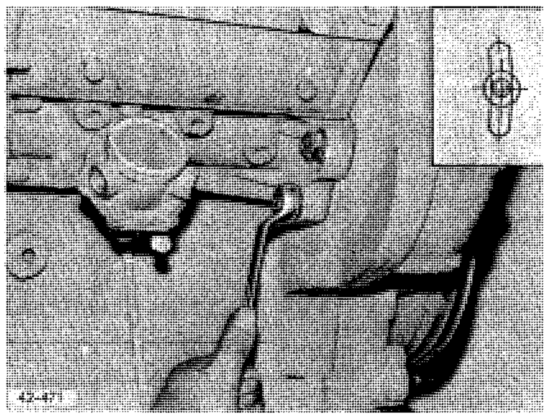


7-106

22. Mount injection pump.

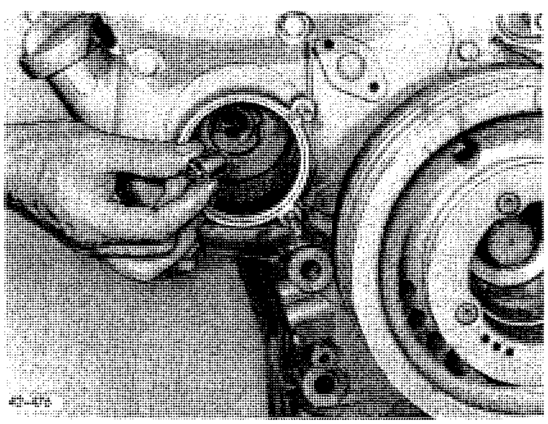
Note:

The Woodruff key must engage in the keyway of the advance/retard unit.
Fig. 7-106



7-107

23. Adjust elongated holes of pump flange to middle position. Tighten nuts.
Fig. 7-107



7-108

24. Screw on clamping nut and tighten as specified.

Note:

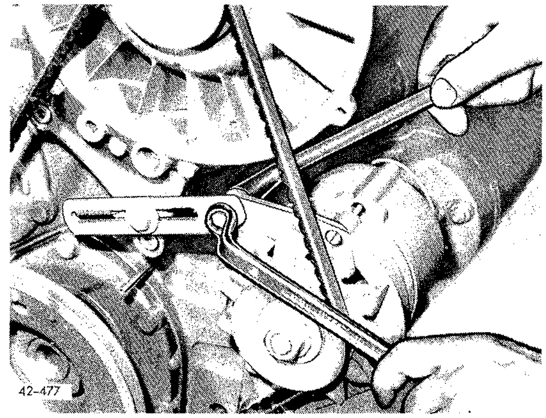
Adjust beginning of delivery, see Chapter 2.
Fig. 7-108

Index

8. Auxiliaries

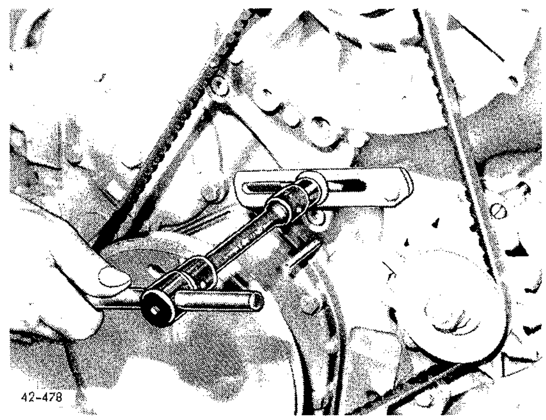
REMOVING AND REFITTING COOLING BLOWER - F2L 912 -

1. Loosen bolt at alternator.
Fig. 8-1



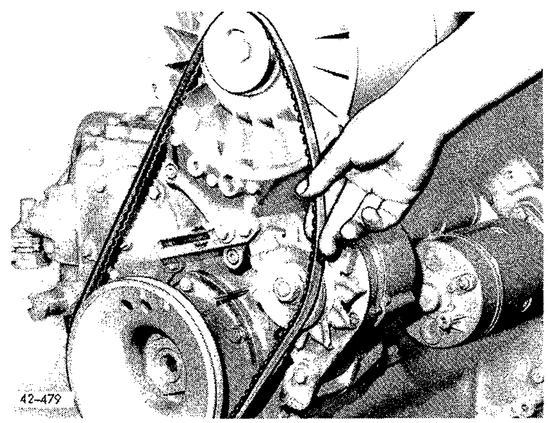
8-1

2. Screw out bolt for the adjusting strap.
Fig. 8-2



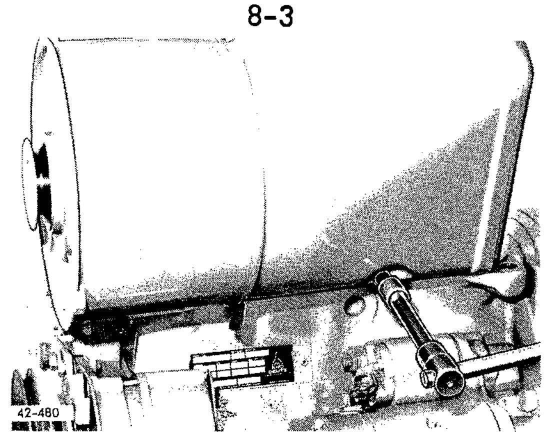
8-2

3. Take off V-belt.
Fig. 8-3

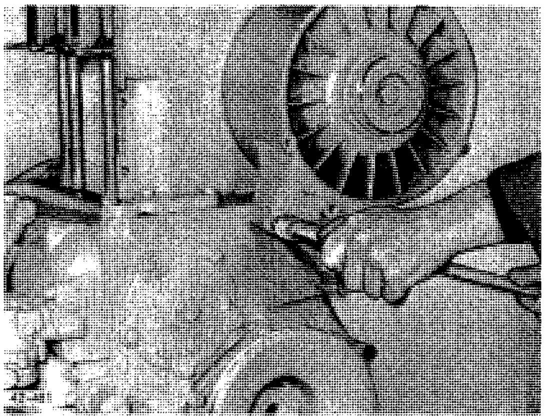


8-3

4. Remove air cowling.
Fig. 8-4

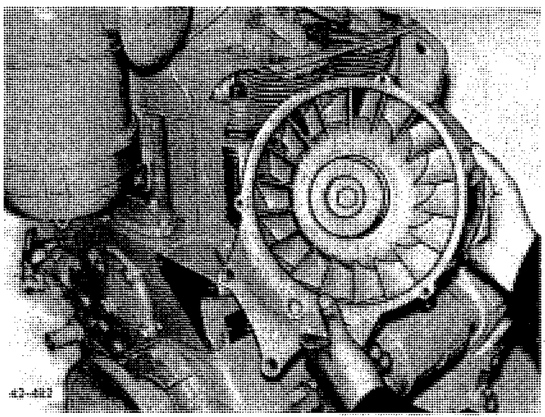


8-4



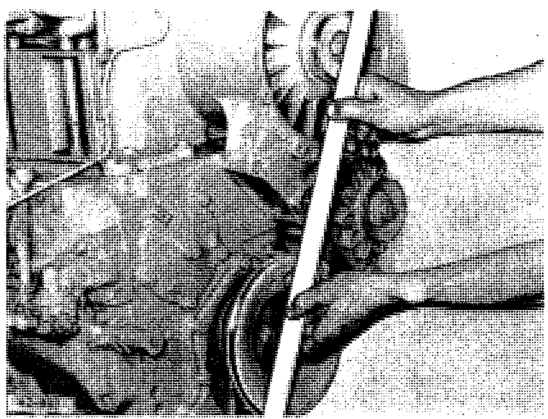
8-5

5. Remove cooling blower.
Fig. 8-5



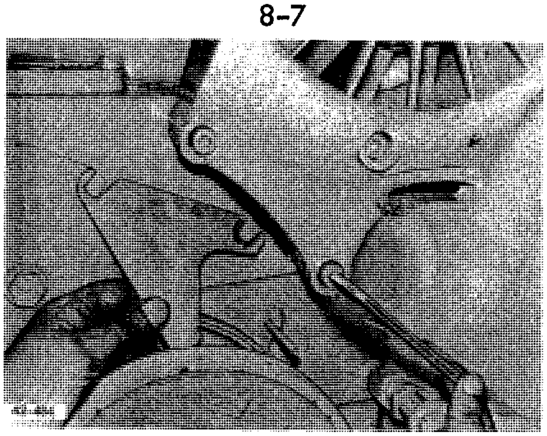
8-6

6. Mount cooling blower.
Fig. 8-6



8-7

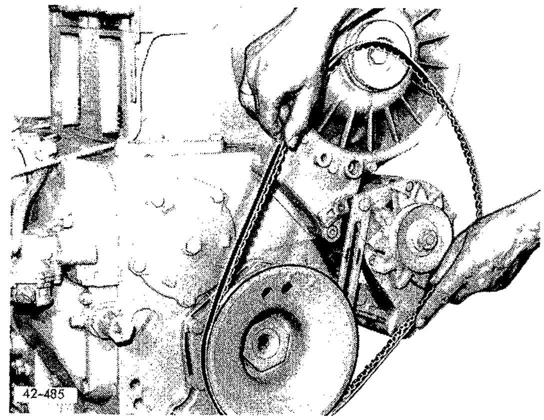
7. Check alignment of V-belt pulleys.
Fig. 8-7



8-8

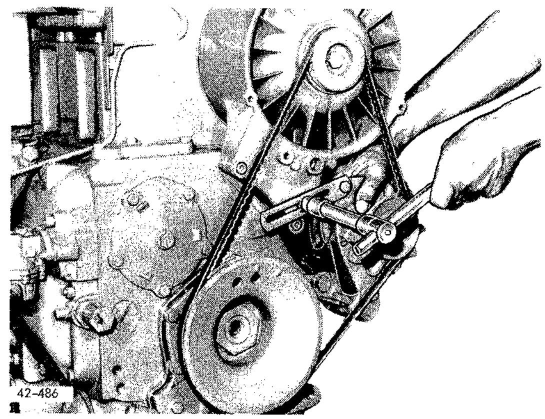
8. Correct any misalignment with shim plates.
Fig. 8-8

9. Place on V-belt.
Fig. 8-9



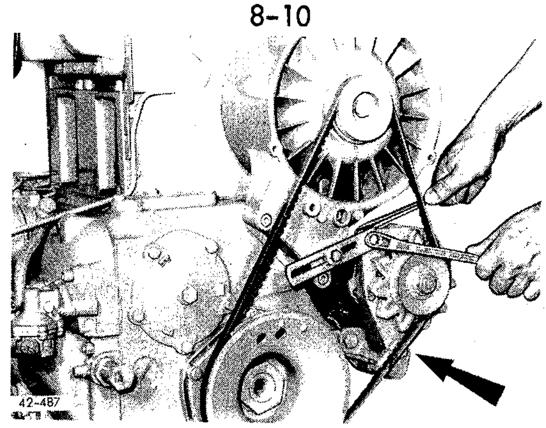
8-9

10. Adjust V-belt tension by pulling round the alternator. Tighten bolt for the adjusting strap.
Fig. 8-10



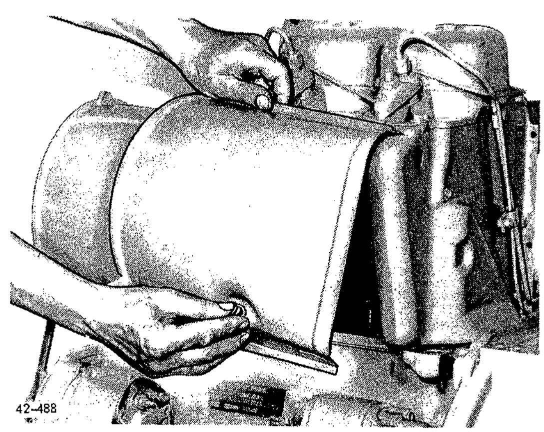
8-10

11. Tighten bolts at alternator.
Fig. 8-11



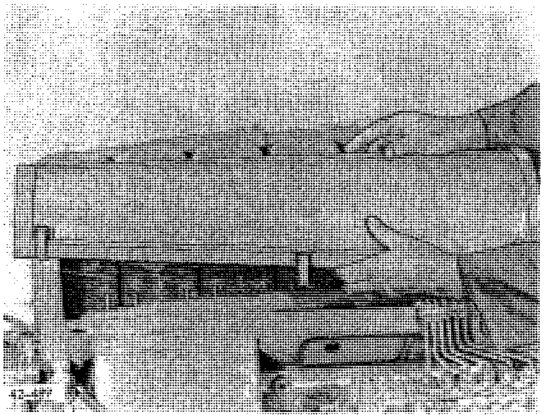
8-11

12. Mount air cowling.
Fig. 8-12



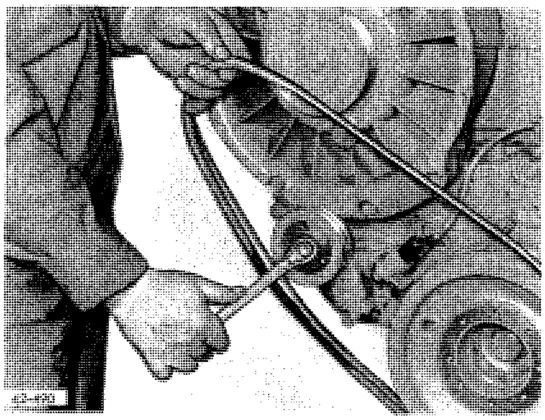
8-12

REMOVING AND REFITTING COOLING BLOWER - as from 3-cyl. engines -



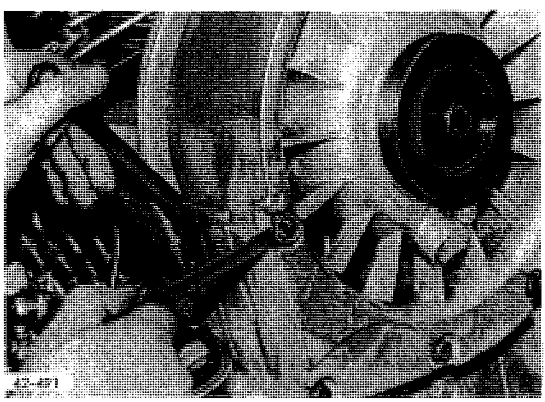
8-13

1. Remove air cowling.
Fig. 8-13



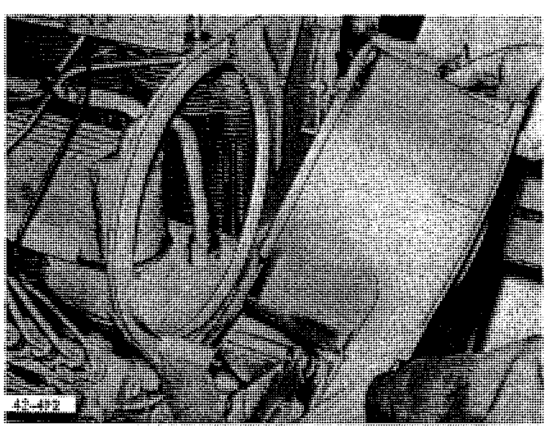
8-14

2. Take off V-belts.
Fig. 8-14



8-15

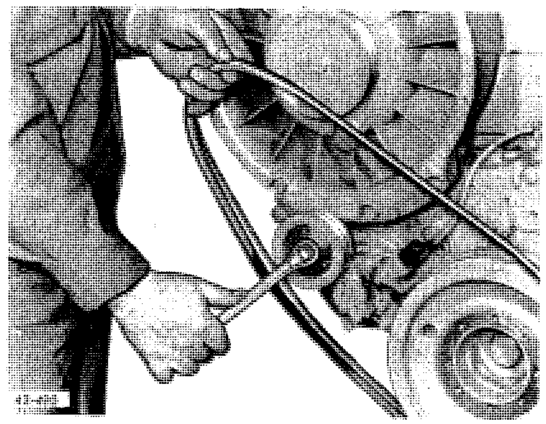
3. Remove cooling blower.
Fig. 8-15



8-16

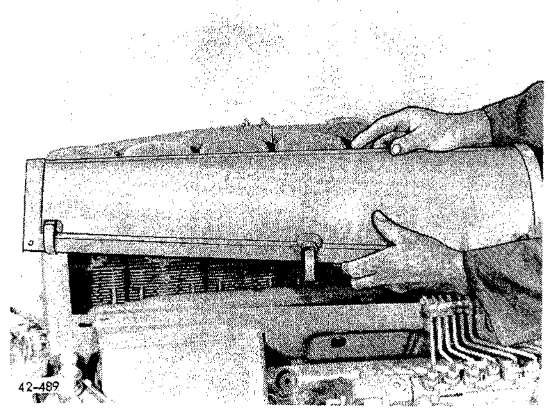
4. Mount cooling blower.
Fig. 8-16

5. Place on V-belts.
Fig. 8-17



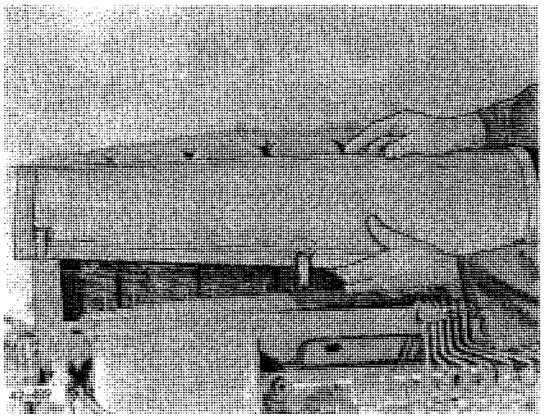
8-17

6. Mount air cowling.
Fig. 8-18



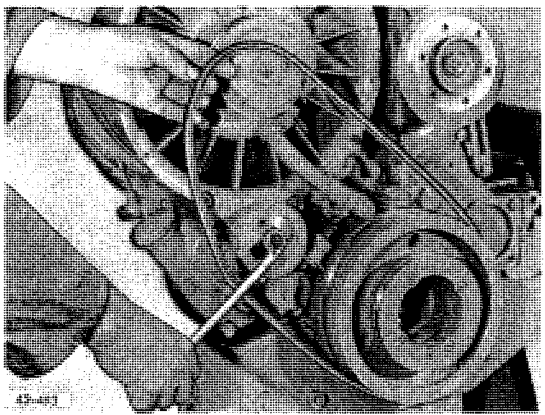
8-18

REMOVING AND REFITTING HYDRAULIC COOLING BLOWER



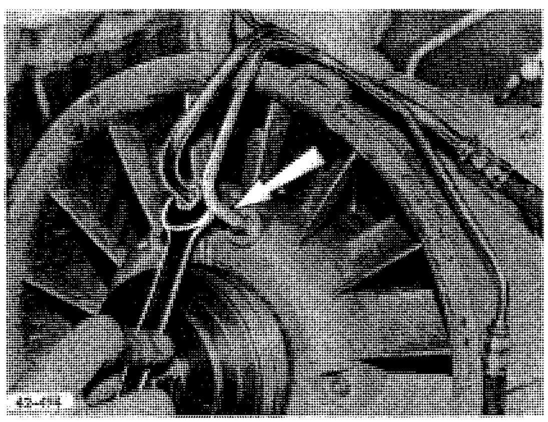
8-19

1. Remove air cowling.
Fig. 8-19



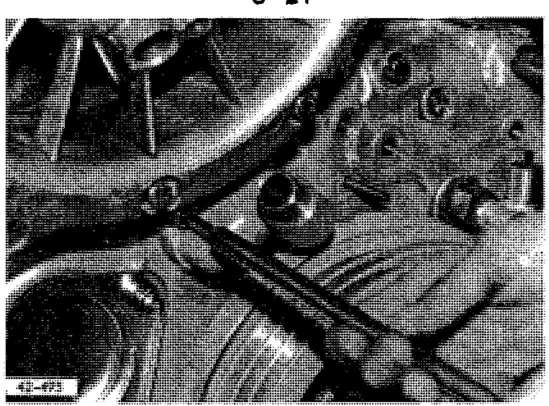
8-20

2. Take off V-belt.
Fig. 8-20



8-21

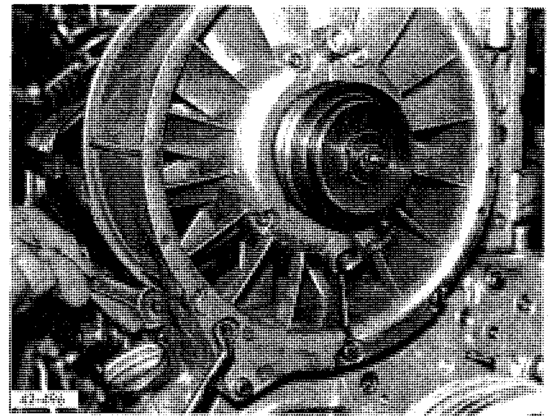
3. Screw off oil lines and venting line.
Fig. 8-21



8-22

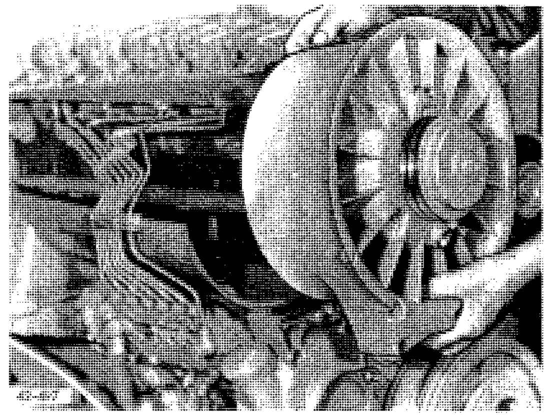
4. Remove connector for oil return pipe.
Fig. 8-22

5. Remove cooling blower.
Fig. 8-23



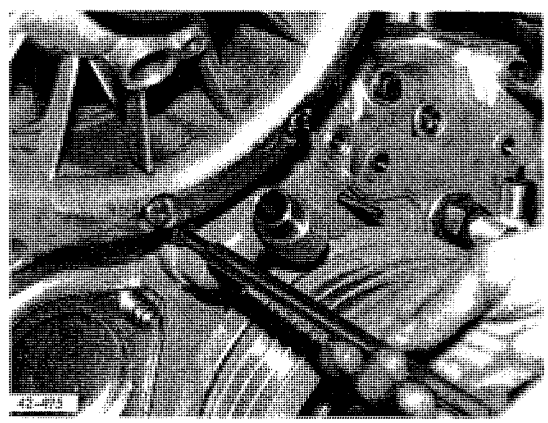
8-23

6. Mount cooling blower.
Fig. 8-24



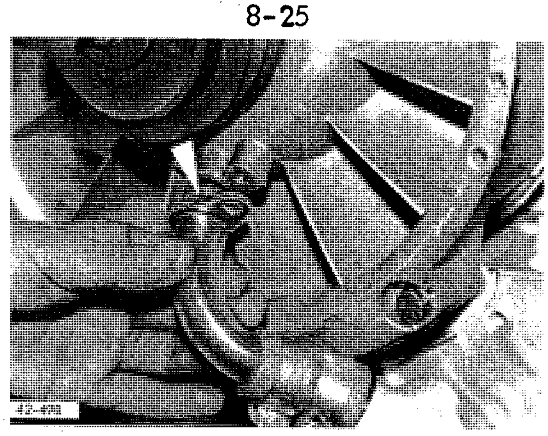
8-24

7. Mount connector for oil return pipe, c/w new gasket.
Fig. 8-25

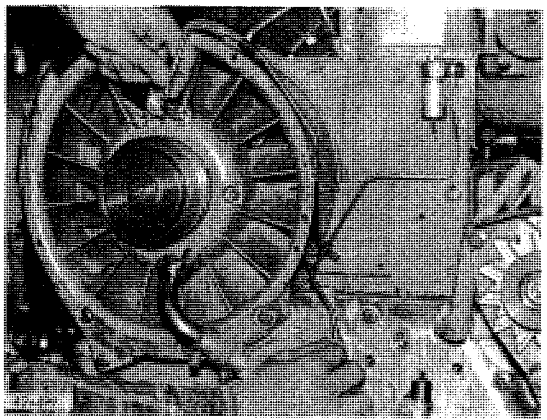


8-25

8. Mount oil return pipe c/w O-seal and rubber sleeve.
Fig. 8-26

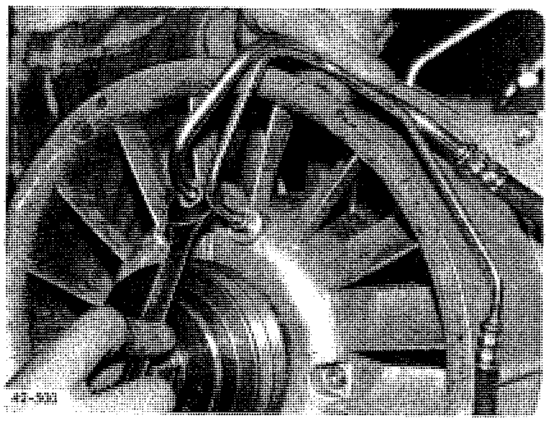


8-26



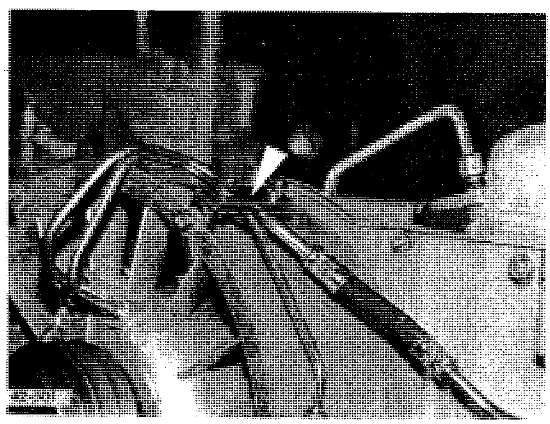
8-27

9. Mount venting line.
Fig. 8-27



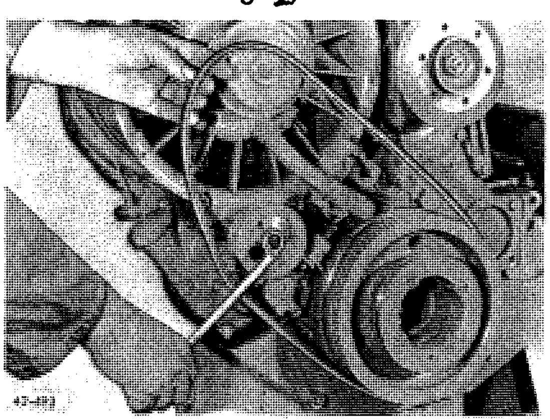
8-28

10. Mount oil feed line.
Fig. 8-28



8-29

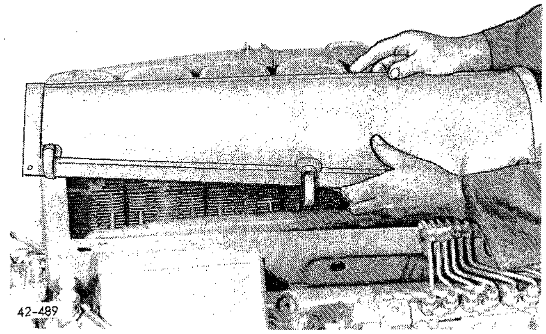
11. Mount pipe clip.
Fig. 8-29



12. Place on V-belt.
Fig. 8-30

8-30

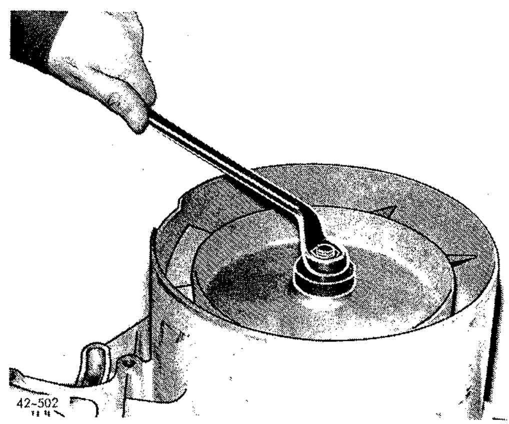
13. Mount air cowling.
Fig. 8-31



8-31

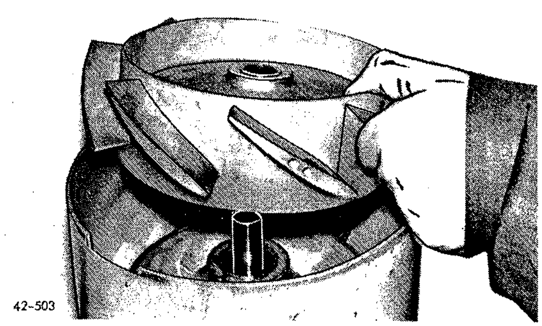
DISMANTLING AND REASSEMBLING COOLING BLOWER - F2L 912 -

1. Clamp cooling blower with clamping bolt in vice.
Screw off nut.
Fig. 8-32

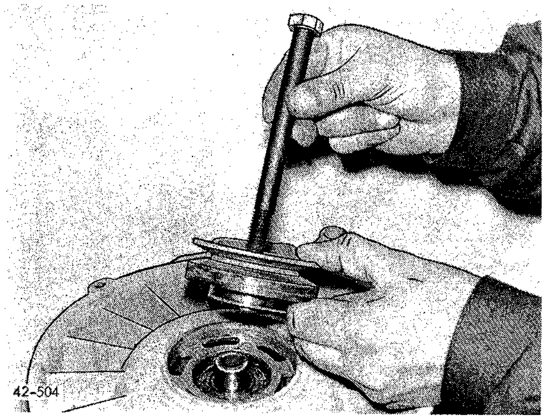


8-32

2. Take off cooling blower impeller.
Fig. 8-33

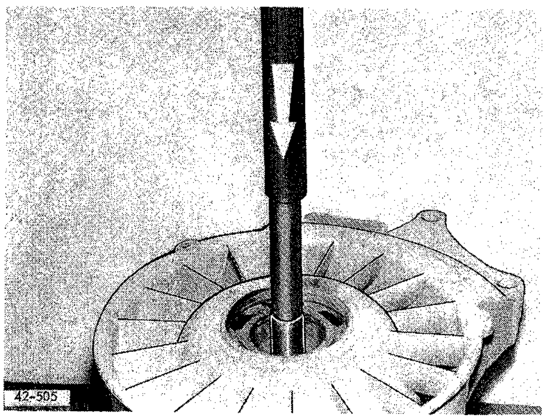


8-33



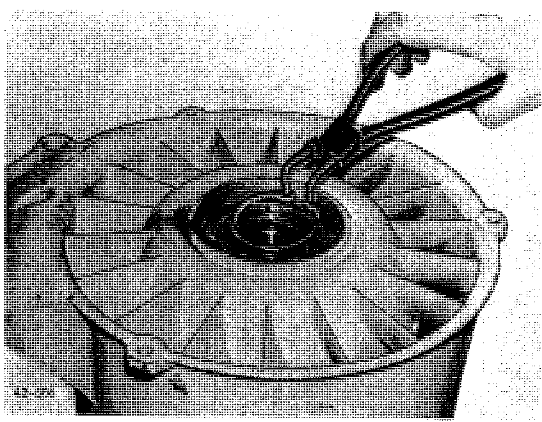
8-34

3. Remove clamping bolt and V-belt pulley.
Fig. 8-34



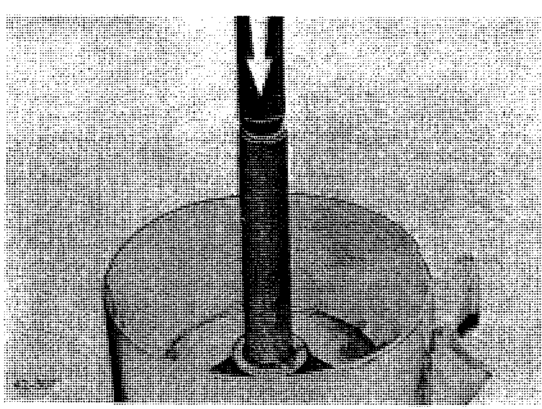
8-35

4. Press out quill shaft.
Fig. 8-35



8-36

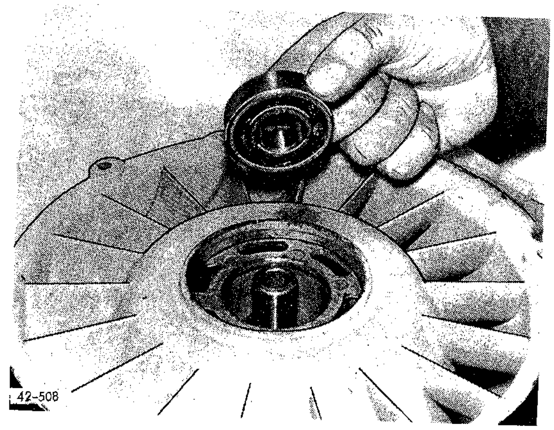
5. Remove circlip.
Fig. 8-36



8-37

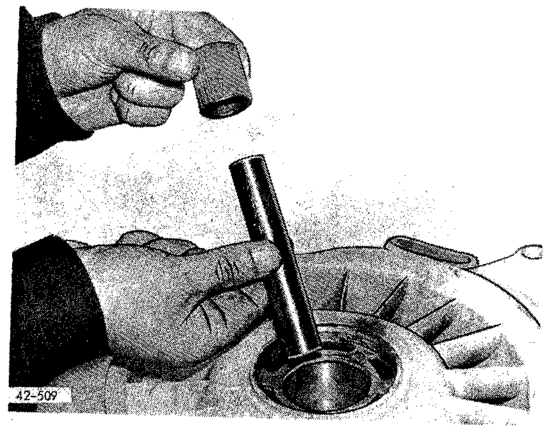
6. Press out ball bearing and spacer bush.
Fig. 8-37

7. Position inner ball bearing with the closed side facing inwards, and press in.
Fig. 8-38



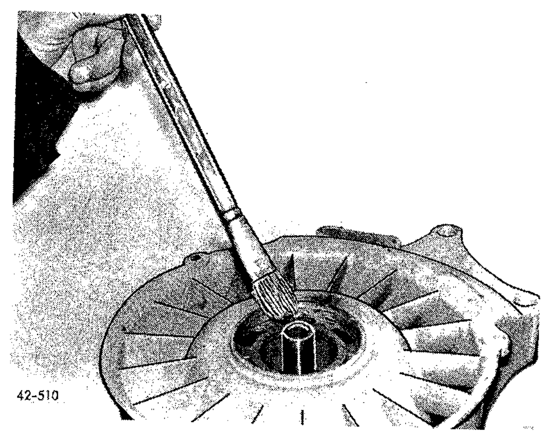
8-38

8. Press in quill shaft and spacer bush.
Fig. 8-39



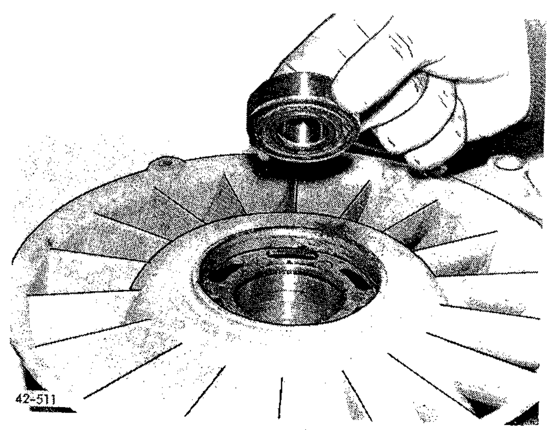
8-39

9. Fill space between spacer bush and housing wall half-full with special Deutz F5 hot-running bearing grease.
Fig. 8-40

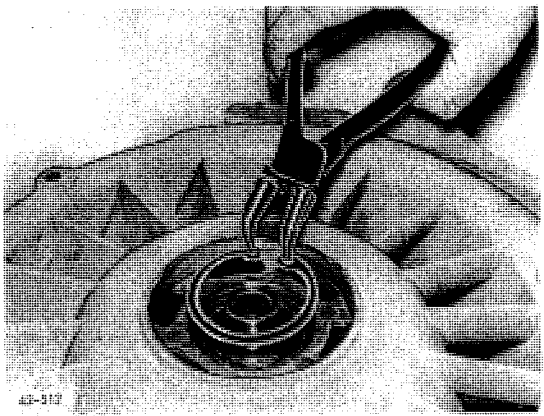


8-40

10. Position outer ball bearing with the closed side facing outwards, and press in.
Fig. 8-41

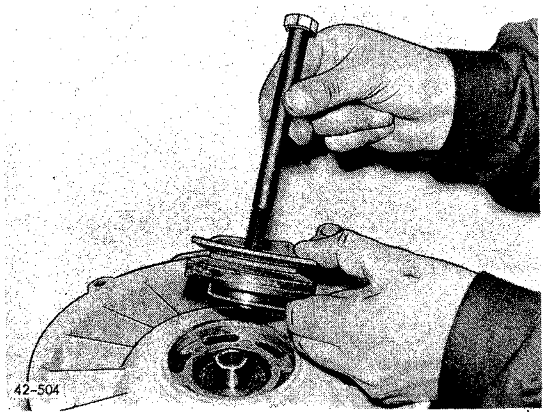


8-41



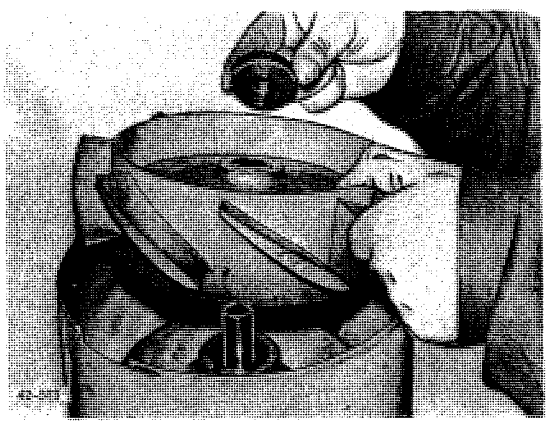
8-42

11. Insert circlip in groove.
Fig. 8-42



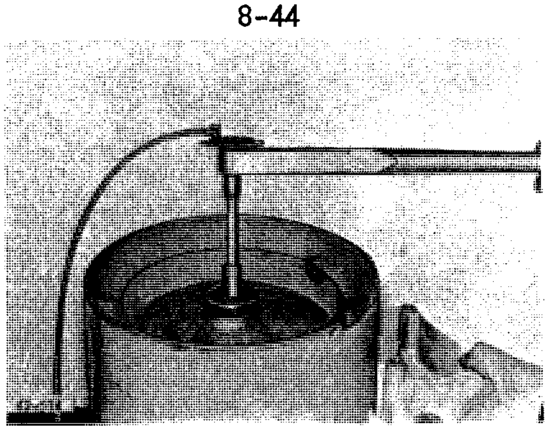
8-43

12. Install V-belt pulley and clamping bolt.
Fig. 8-43



8-44

13. Clamp cooling blower with clamping bolt in vice. Place on blower impeller with stop washer.
Fig. 8-44

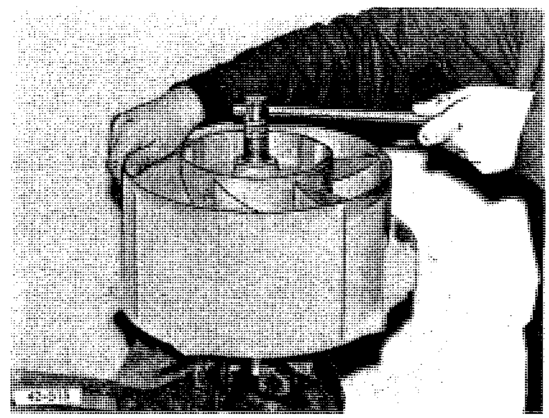


8-45

14. Screw on nut and tighten as specified.
Fig. 8-45

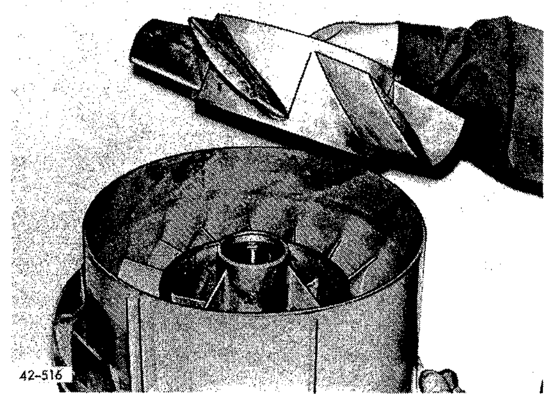
DISMANTLING AND REASSEMBLING COOLING BLOWER - as from 3-cyl. engines -

1. Clamp cooling blower with clamping bolt in vice. Screw off nut.
Fig. 8-46



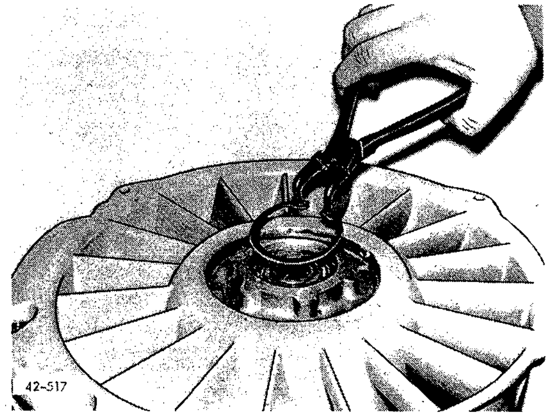
8-46

2. Take off cooling blower impeller.
Fig. 8-47

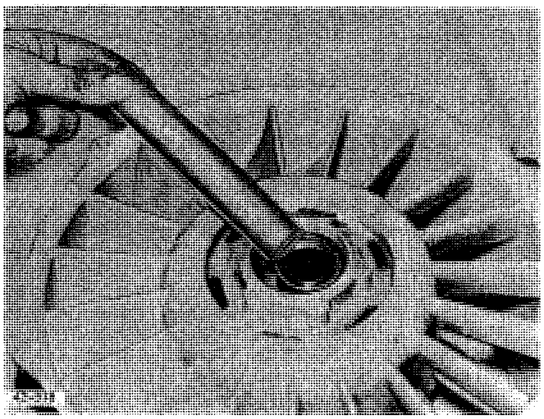


8-47

3. Remove circlip.
Fig. 8-48

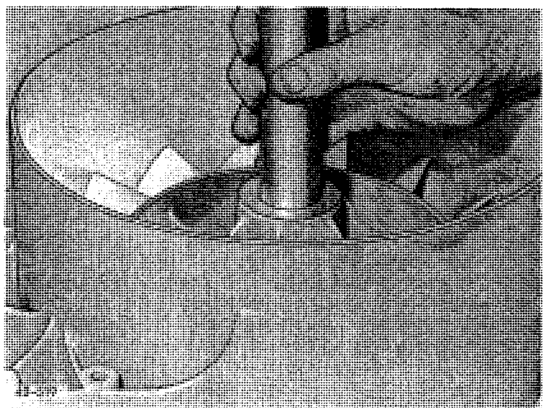


8-48



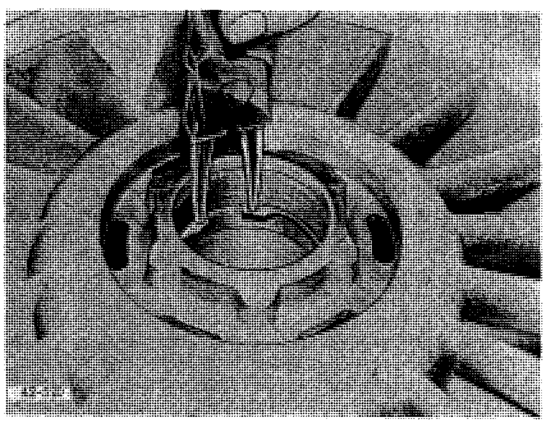
8-49

4. Remove quill shaft.
Fig. 8-49



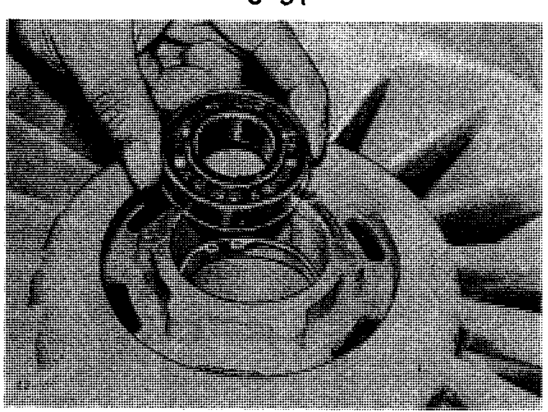
8-50

5. Press out ball bearing and spacer bush.
Fig. 8-50



8-51

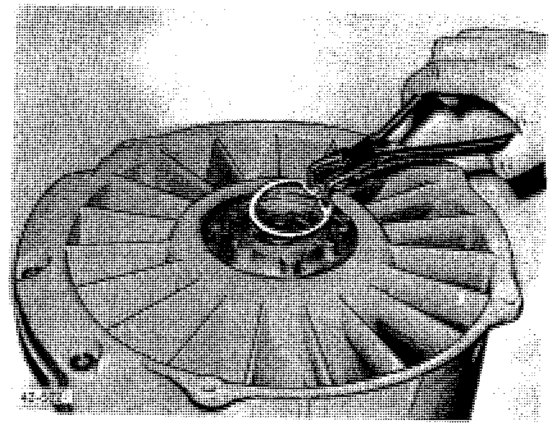
6. Insert circlip.
Fig. 8-51



8-52

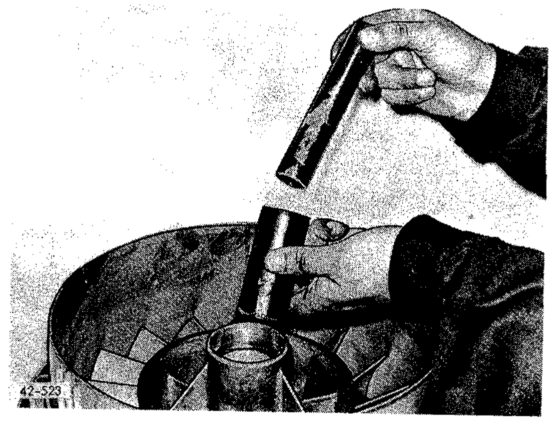
7. Press in ball bearing with the closed side facing outwards.
Fig. 8-52

8. Insert second circlip.
Fig. 8-53



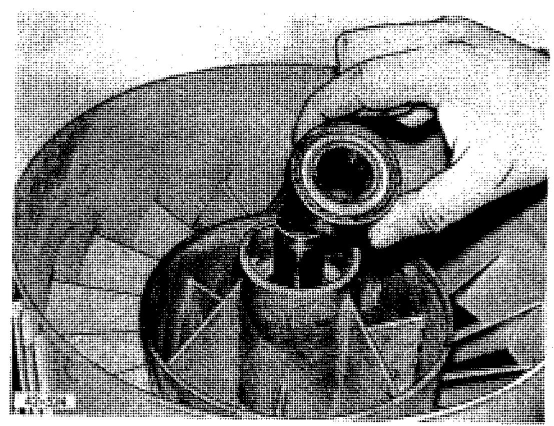
8-53

9. Insert quill shaft and spacer bush. Fill space between spacer bush and housing wall half-full with special Deutz F5 hot-running bearing grease.
Fig. 8-54



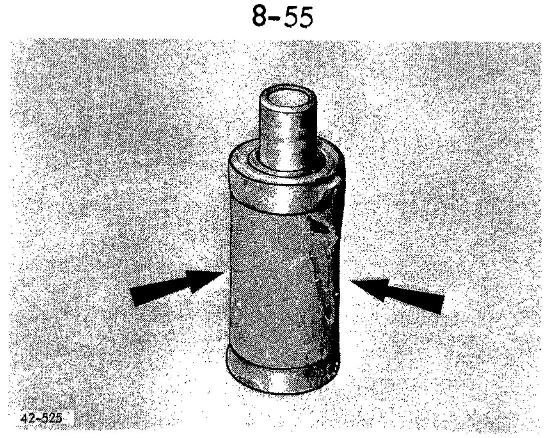
8-54

10. Press in second ball bearing with the closed side facing outwards.
Fig. 8-55

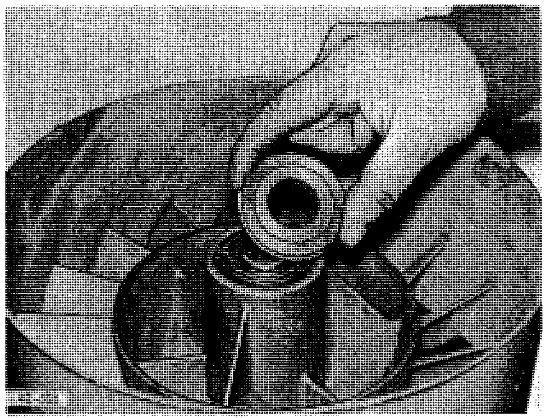


8-55

11. For BF6L 913 engines, preassemble shaft with spacer bush and ball bearings, fill with grease, and press into blower housing.
Fig. 8-56

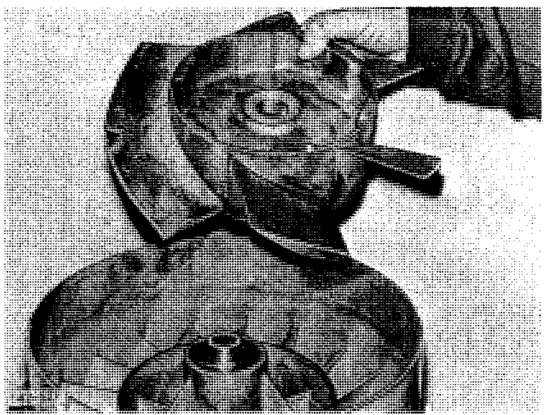


8-56



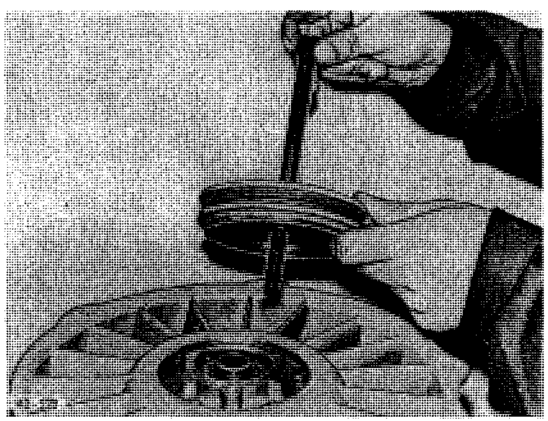
8-57

12. Place on spacer.
Fig. 8-57



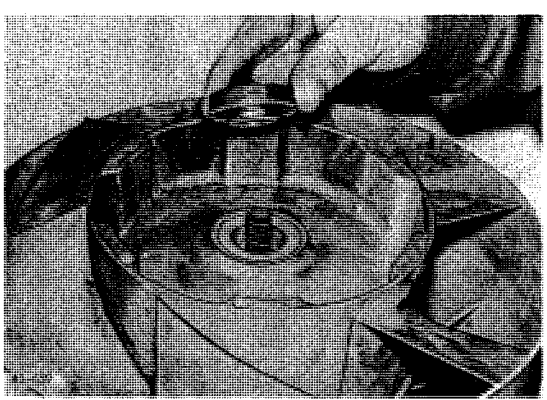
8-58

13. Mount cooling blower impeller.
Fig. 8-58



8-59

14. Install V-belt pulley with clamping bolt.
Fig. 8-59

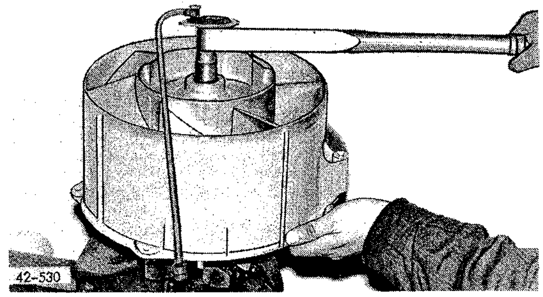


8-60

15. Clamp cooling blower with clamping bolt in vice and place on stop washer.
Fig. 8-60

16. Screw on nut and tighten as specified.
Fig. 8-61

918

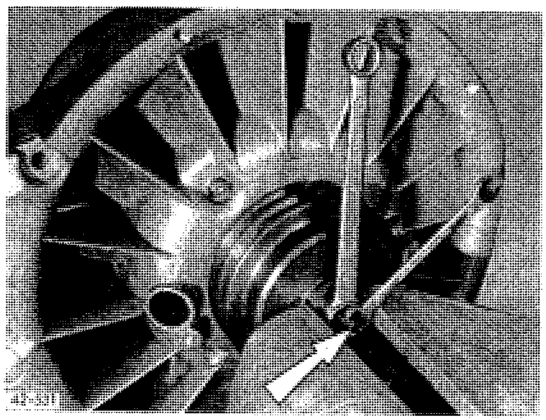


8-61

DISMANTLING AND REASSEMBLING HYDRAULIC COOLING BLOWER

Special tool required:

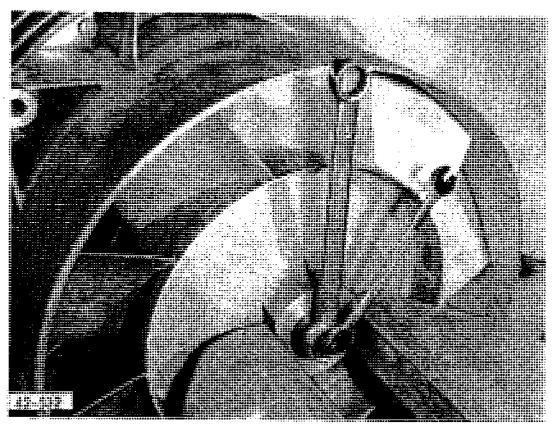
Mandrel for shaft seal No. 160260



8-62

1. o Clean thread and oil well.
   o Clamp cooling blower in vice at flats of V-belt pulley.
   o While counter-holding at flats of bolt (arrow), undo sealing nut.
   o Take off V-belt pulley.

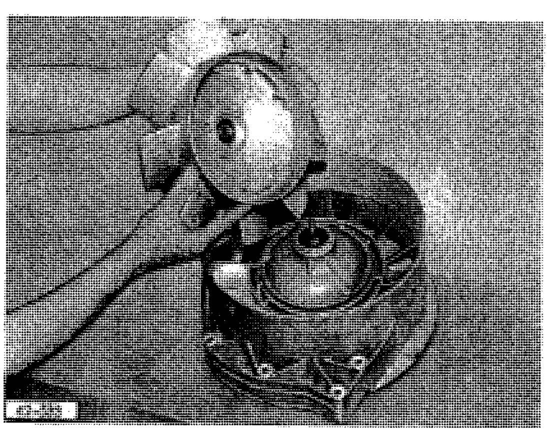
Fig. 8-62



8-63

2. Undo sealing nut at opposite end.

Fig. 8-63

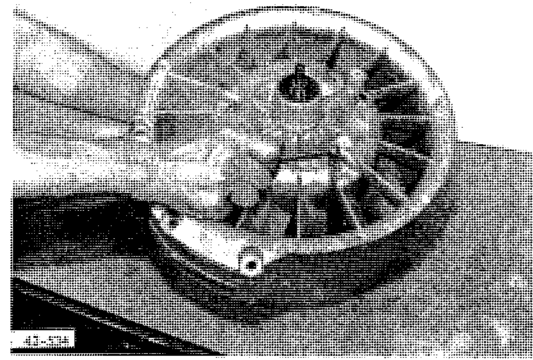


8-64

3. Take out blower impeller.

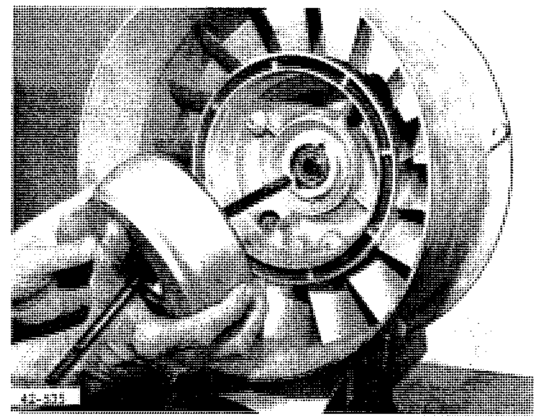
Fig. 8-64

4. Remove cheese-head screw for inner cover. Take off cover.
Fig. 8-65



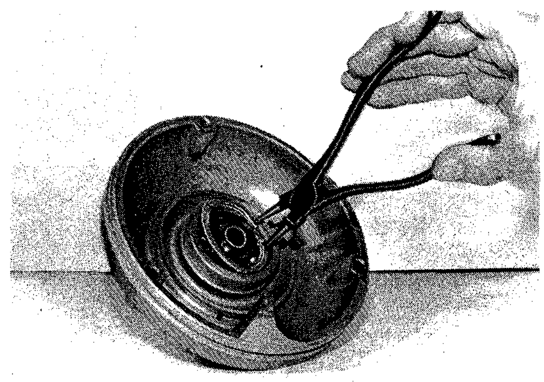
8-65

5. Take out coupling.
Fig. 8-66



8-66

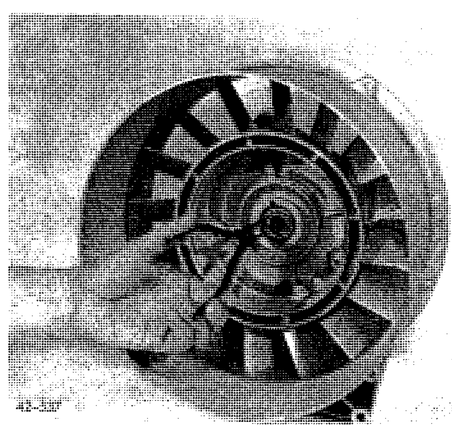
6. Remove circlip in cover.
Fig. 8-67



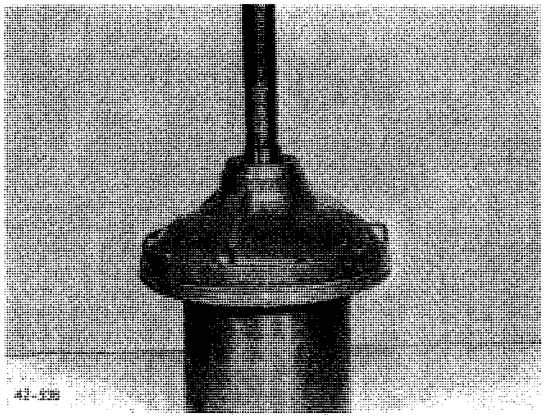
42-536

8-67

7. Remove circlip in hub of blower casing.
Fig. 8-68

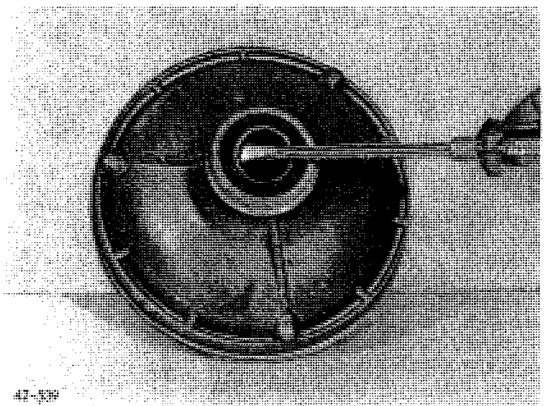


8-68



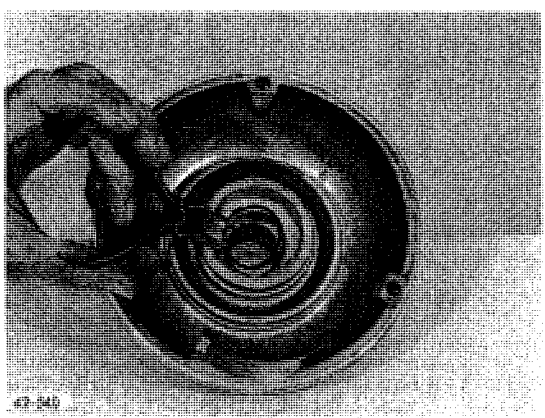
8-69

8. Press shaft with ball bearing out of cover. Press ball bearing off shaft.
Fig. 8-69



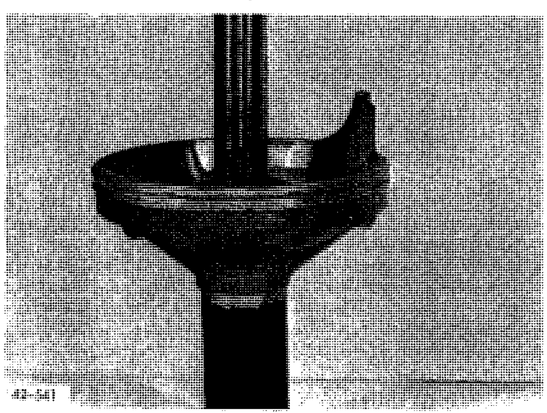
8-70

9. Prise out shaft seal.
Fig. 8-70



8-71

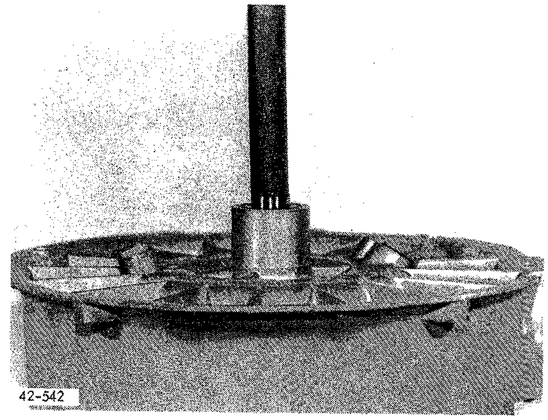
10. Remove circlips for needle bearing.
Fig. 8-71



8-72

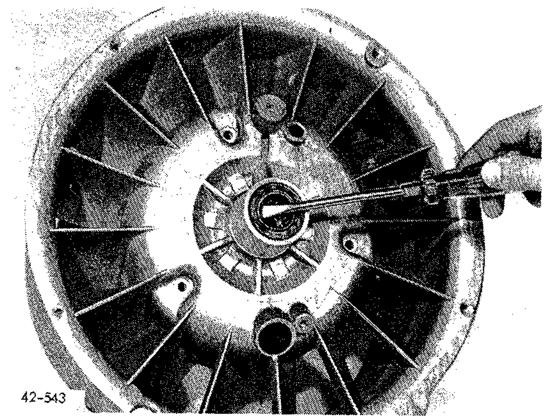
11. Press needle bearing out of cover.
Fig. 8-72

12. Press shaft with inclined ball bearing out of blower casing hub. Press inclined ball bearing off shaft.
Fig. 8-73



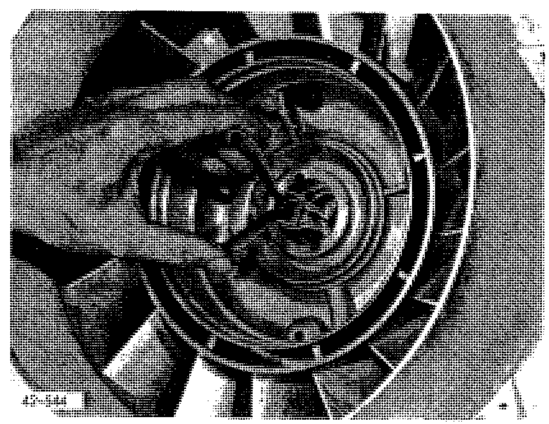
8-73

13. Prise out shaft seal.
Fig. 8-74

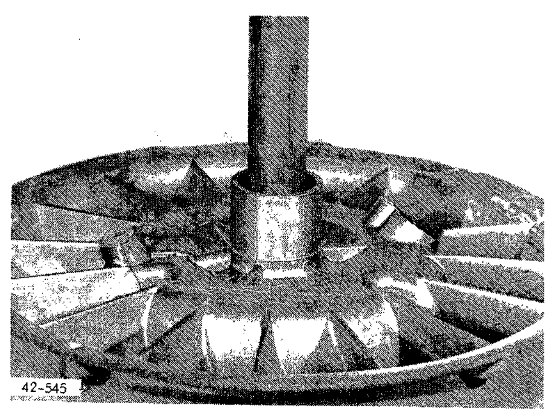


8-74

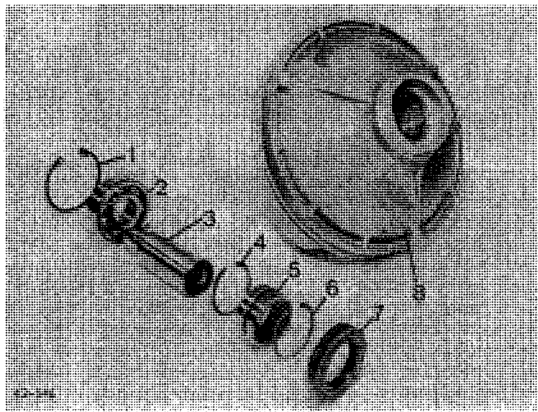
14. Remove circlips for needle bearing.
Fig. 8-75


8-75

15. Press needle bearing out of hub.
Fig. 8-76

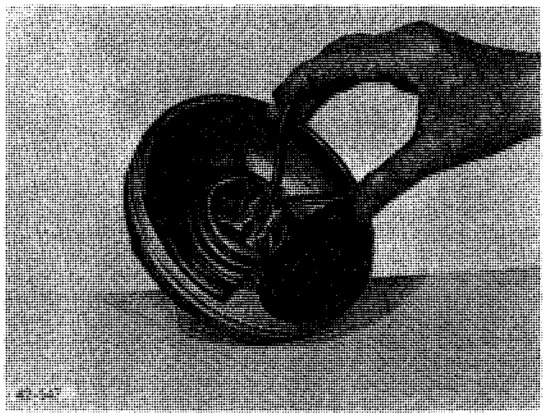


8-76

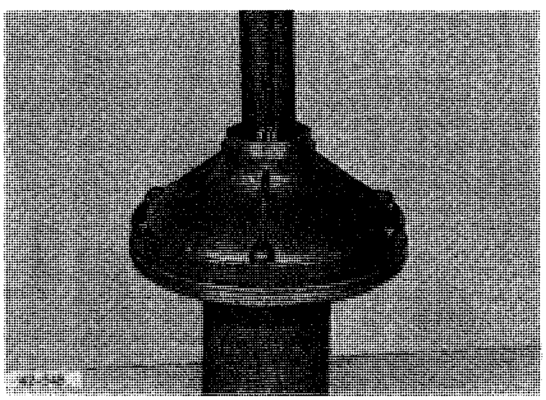


8-77

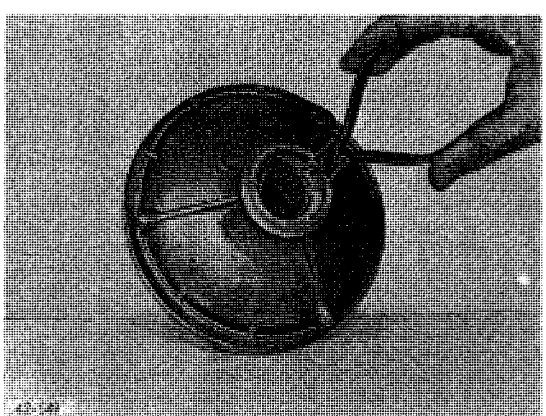
16. Components of cover:
1 Circlip
2 Ball bearing
3 Shaft
4 Inner circlip
5 Needle bearing
6 Outer circlip
7 Shaft seal
8 Cover
Fig. 8-77


8-78

17. Install inner circlip, item 4, in cover.
Fig. 8-78

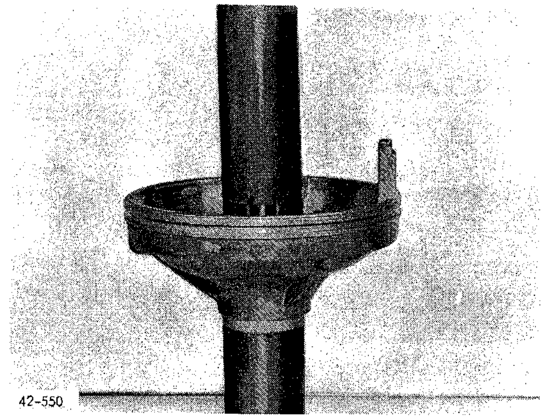

8-79

18. Press in needle bearing.
Fig. 8-79


8-80

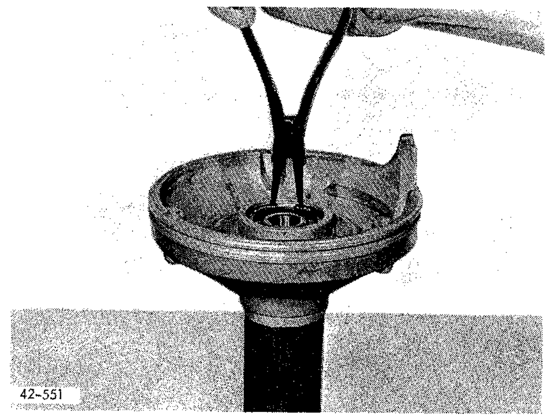
19. Install outer circlip.
Fig. 8-80

20. Press ball bearing, item 2, at outer ring into cover. Fig. 8-81



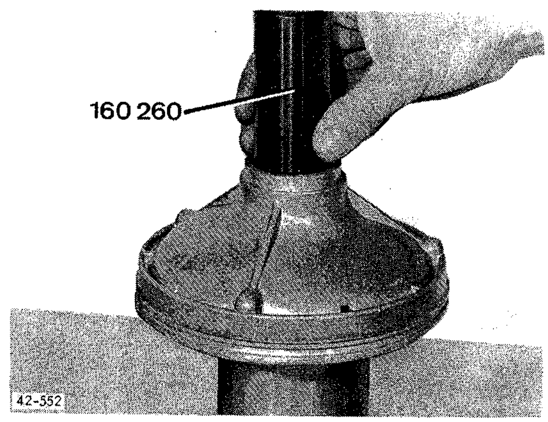
8-81

21. Install circlip, item 1, for ball bearing. Fig. 8-82



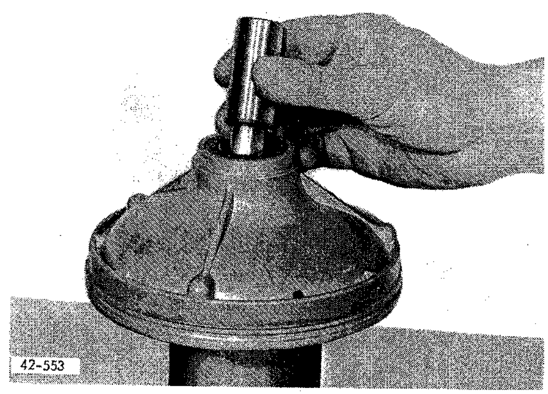
8-82

22. With special tool, press in shaft seal, item 7, flush. Fig. 8-83

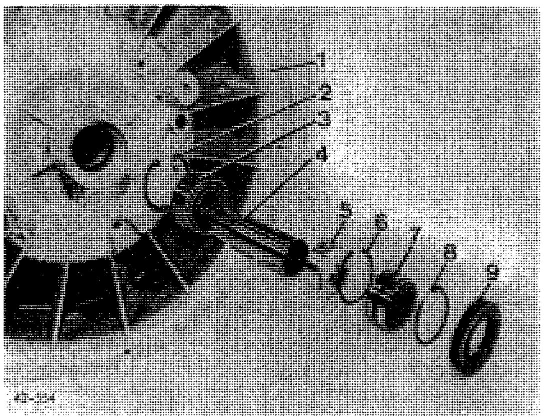


8-83

23. Support cover on inner ring of ball bearing. Guide shaft, item 3, carefully through shaft seal and press into ball bearing. Fig. 8-84

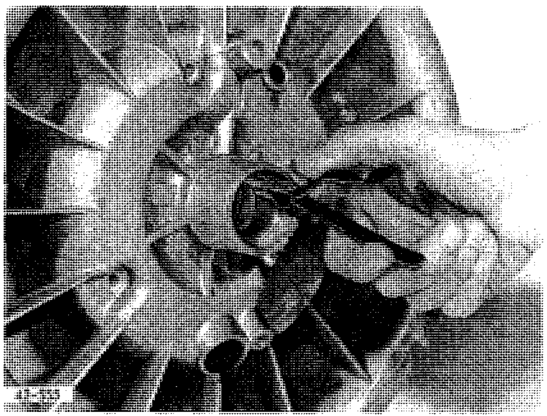


8-84



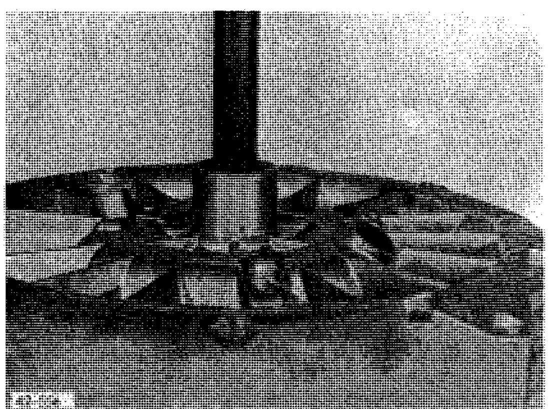
8-85

24. Components of hub of vane ring assembly:
1 Vane ring
2 Circlip
3 Inclined ball bearing
4 Shaft
5 Sleeve
6 Inner circlip
7 Needle bearing
8 Outer circlip
9 Shaft seal
Fig. 8-85



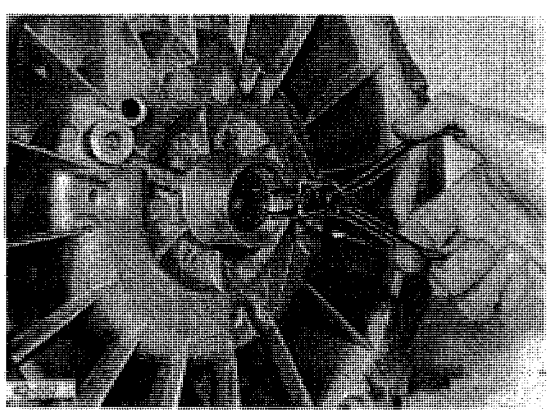
8-86

25. Install inner circlip, item 6, in hub.
Fig. 8-86



8-87

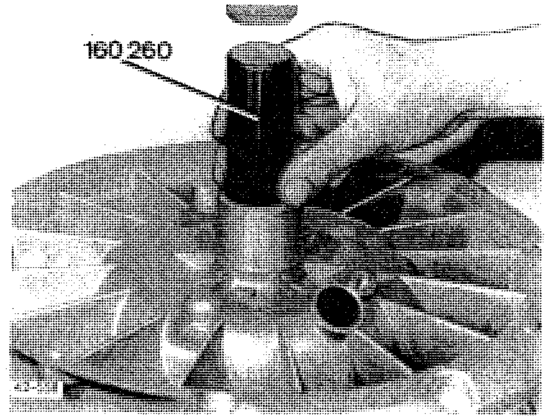
26. Press in needle bearing, item 7.
Fig. 8-87



8-88

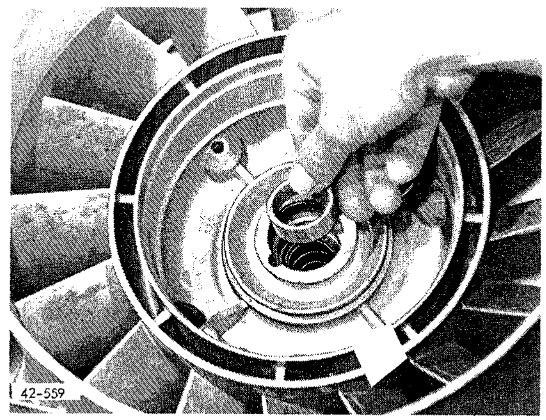
27. Install outer circlip, item 8.
Fig. 8-88

28. Press in shaft seal, item 9, flush.
Fig. 8-89



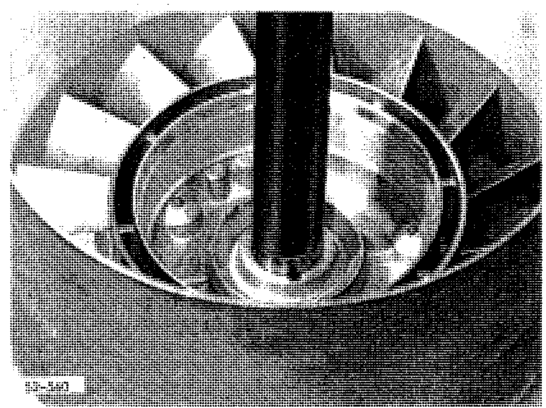
8-89

29. Insert sleeve, item 5.
Fig. 8-90



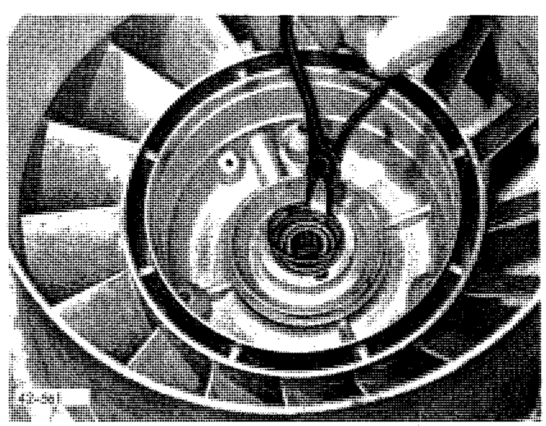
8-90

30. Press in inclined ball bearing, item 3, at outer ring.
Fig. 8-91

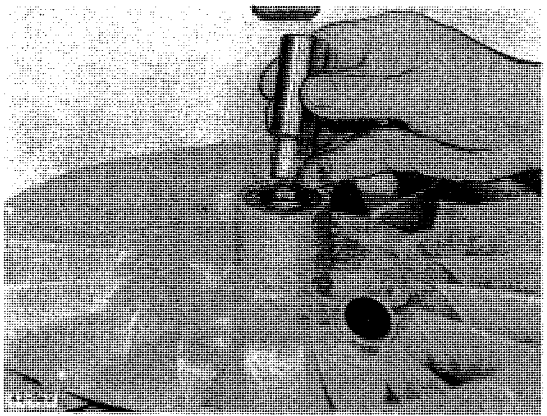


8-91

31. Install circlip, item 2.
Fig. 8-92

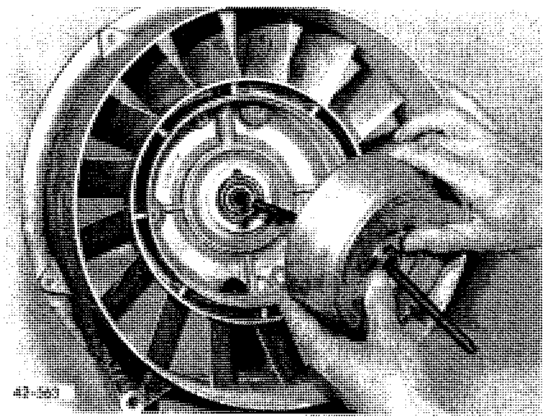


8-92



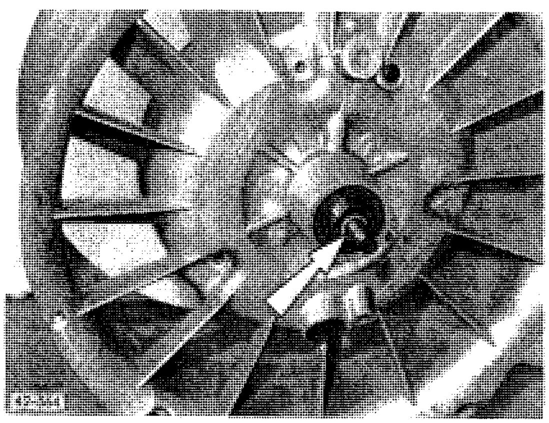
8-93

32. Support hub of vane ring on inner ring of the inclined ball bearing. Guide shaft, item 4, carefully through shaft seal and press into the inclined ball bearing.
Fig. 8-93



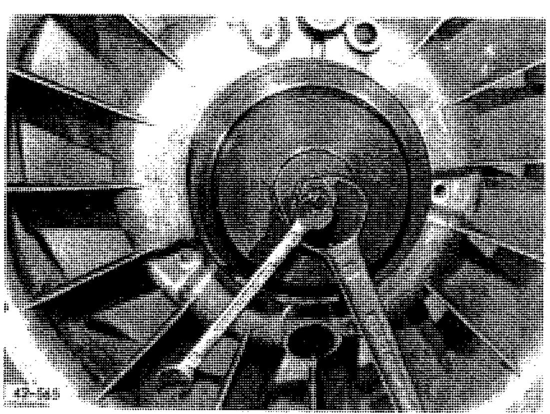
8-94

33. Insert coupling.
Fig. 8-94



8-95

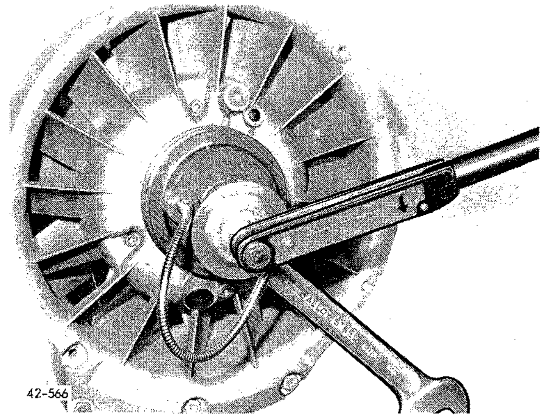
34. Push on O-seal.
Fig. 8-95



8-96

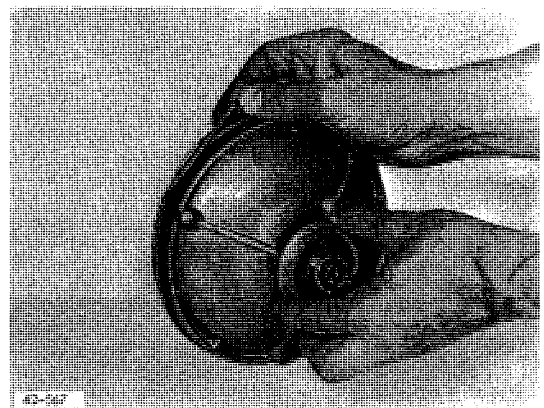
35. o Oil thread.
o Screw on new sealing nut, while counter-holding at the bolt flats.
Fig. 8-96

36. Tighten sealing nut as specified.
Fig. 8-97



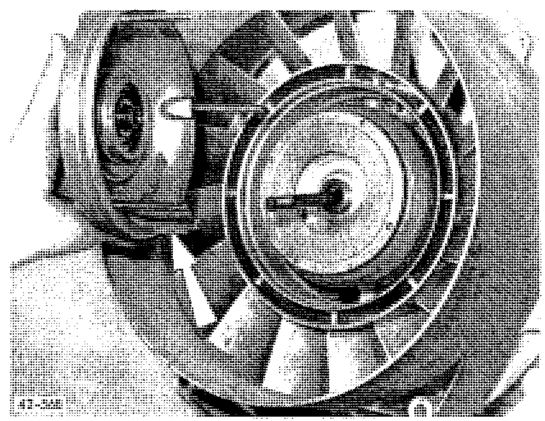
8-97

37. Place new O-seal on cover and apply a film of antifriction grease.
Fig. 8-98



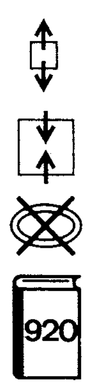
8-98

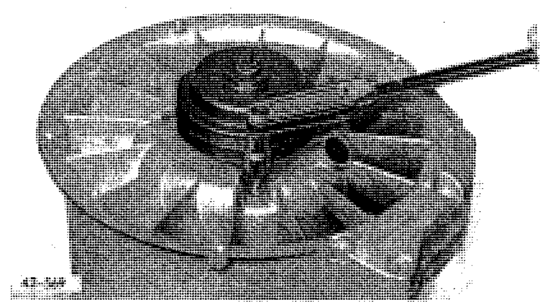
38. To simplify mounting of the cover, insert three studs. Mount cover, ensuring that the oil deflector boss (arrow) is situated at oil drain of cooling blower.
Fig. 8-99



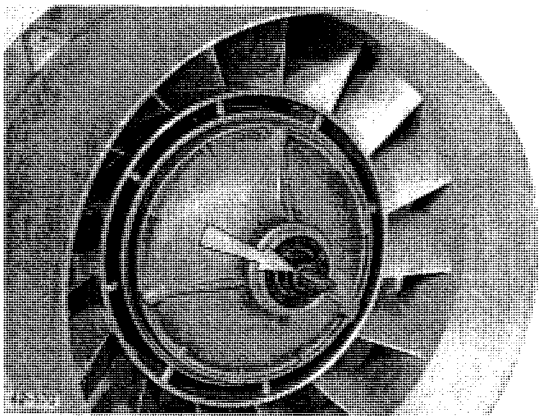
8-99

39. Screw out studs. Screw in cheese-head screws c/w new sealing rings and tighten as specified.
Fig. 8-100



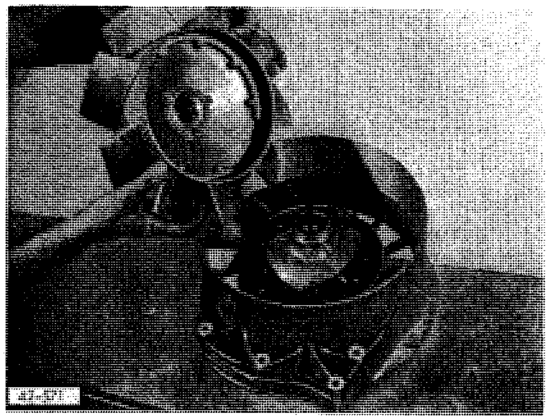


8-100



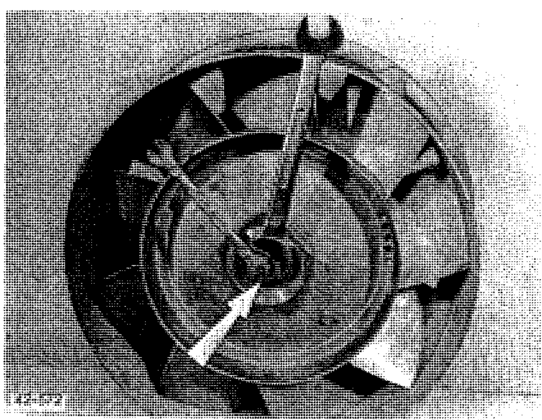
8-101

40. Push on O-seal.
Fig. 8-101



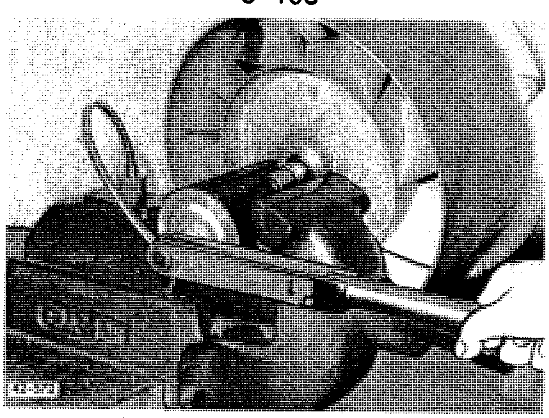
8-102

41. Insert blower impeller.
Fig. 8-102



8-103

42. Oil thread. Screw on new sealing nut, while counter-holding at the bolt flate.
Fig. 8-103



8-104

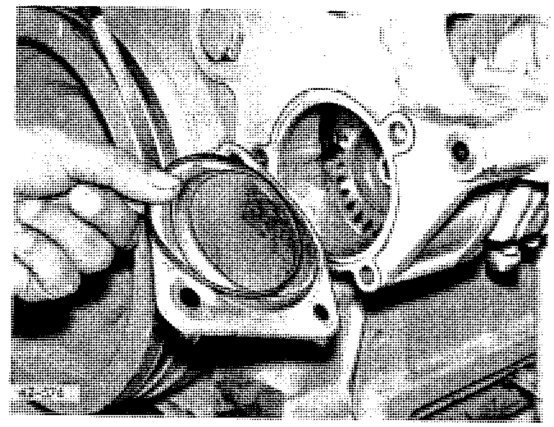
43. Tighten sealing nut as specified.
Fig. 8-104

REMOVING AND REFITTING HYDRAULIC PUMP

Special tools required:

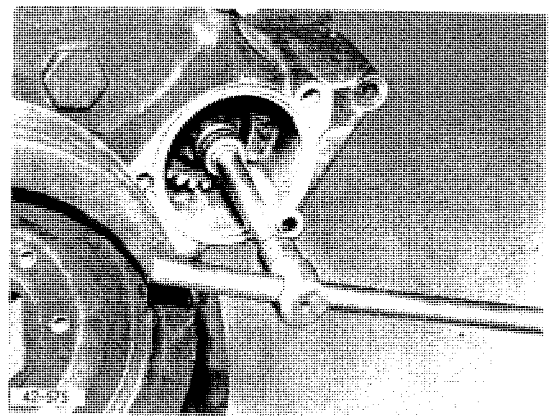
Puller (old design) .. No. 144700
Puller (new design) .. No. 144750

1. Remove cover.
Fig. 8-105



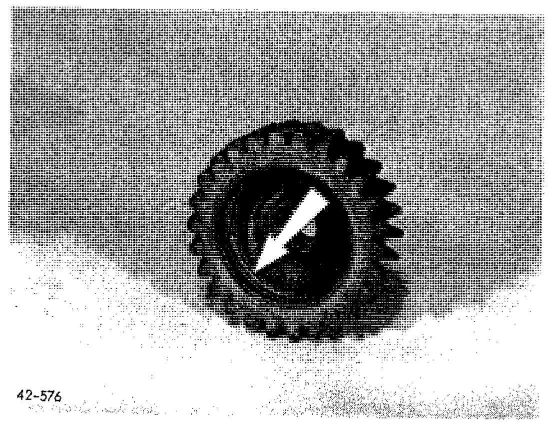
8-105

2. Screw out nut on shaft of hydraulic pump.
Fig. 8-106



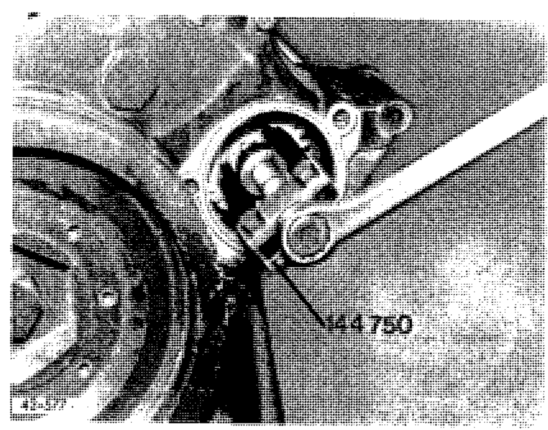
8-106

Gear of new design has inner groove.
Fig. 8-107

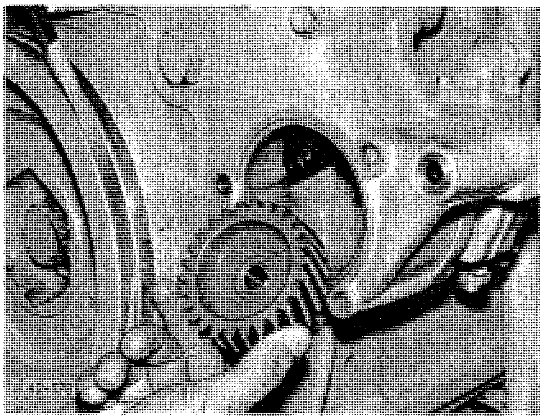


8-107

3. Fit puller (new design) in inner groove and pull gear off shaft.
Fig. 8-108

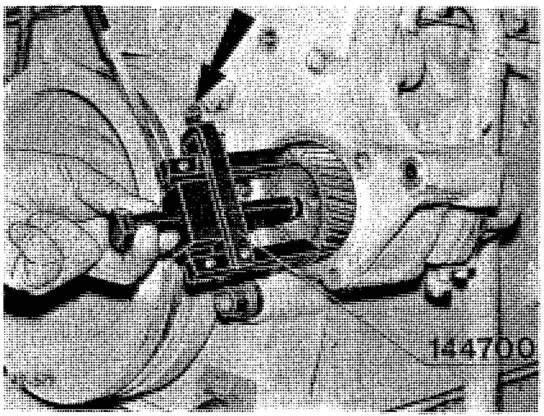


8-108



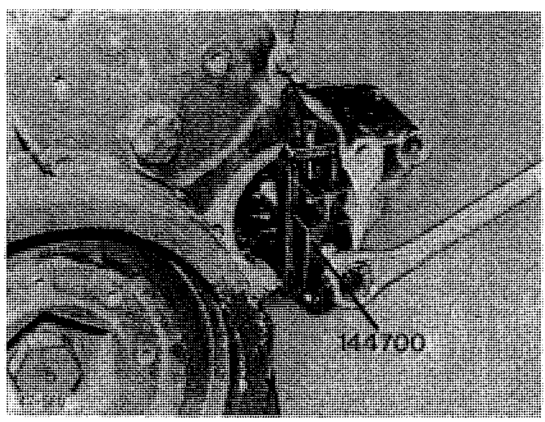
8-109

4. Gear of old design has no inner groove.
Fig. 8-109



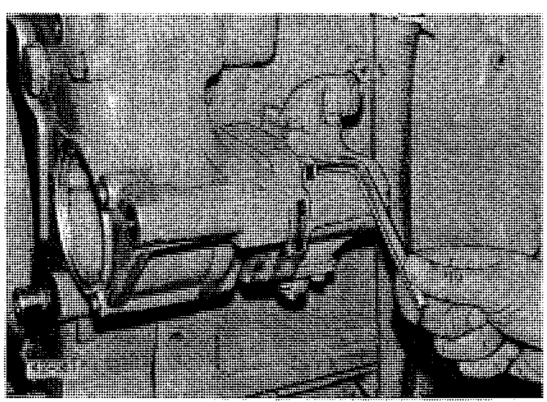
8-110

5. Fit puller (old design) at gear periphery. Tighten clamping yoke of puller.
Fig. 8-110



8-111

6. Pull gear off shaft.
Fig. 8-111



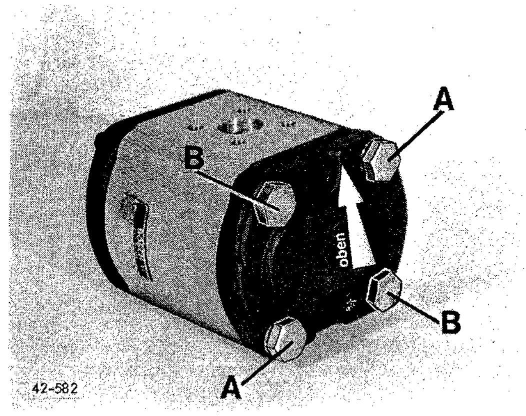
8-112

7. Remove hydraulic pump.
Fig. 8-112

8. To release hydraulic pump at engine, screw out fastening bolts "B" only.
Fig. 8-113

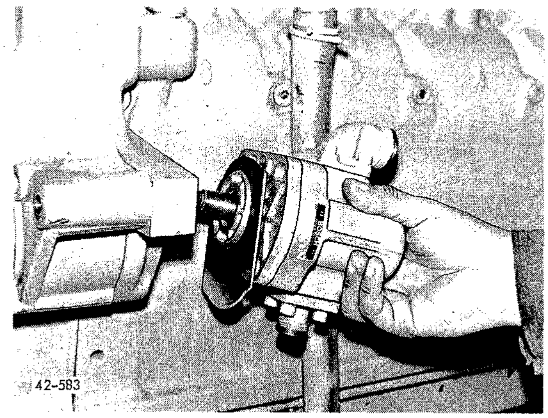
Note:

Screw "A" are fastening screws of the lid.



8-113

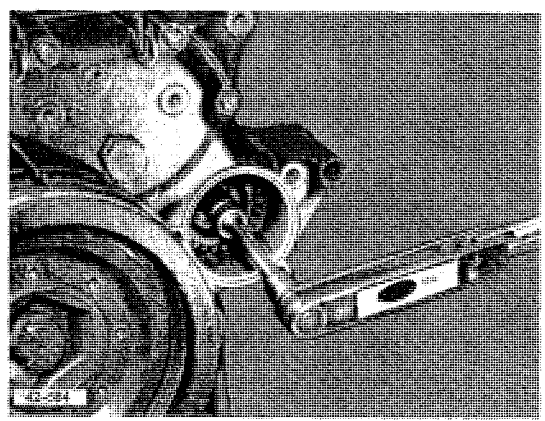
9. Mount hydraulic pump c/w new sealing ring.
Fig. 8-114



8-114

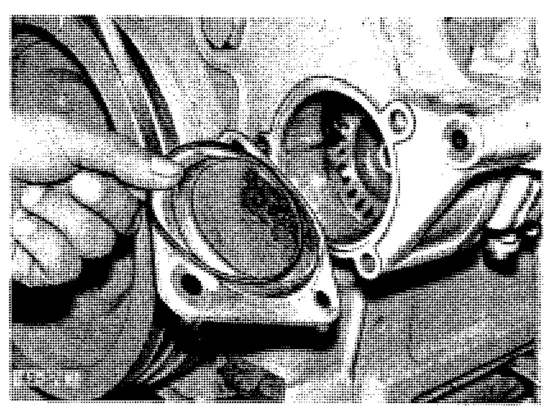
10. Tighten nut as specified.
Fig. 8-115

915

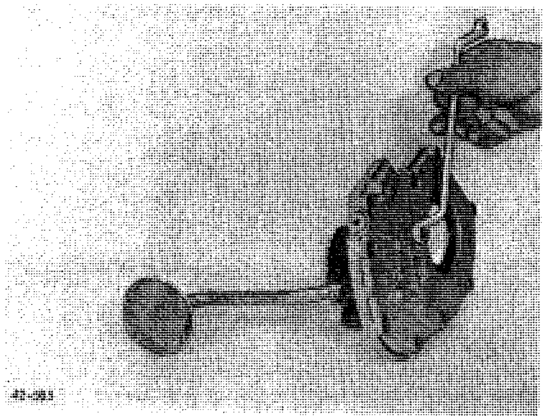


8-115

11. Place on O-seal and mount cover.
Fig. 8-116



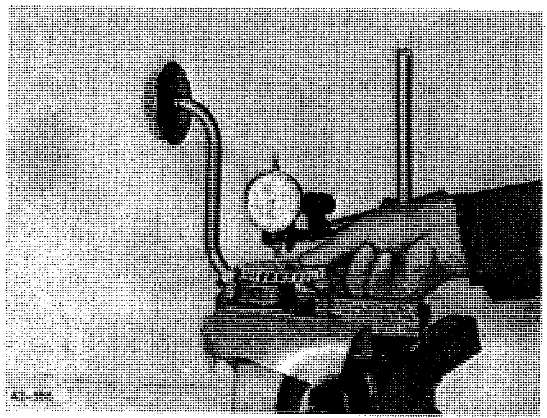
8-116



8-117

CHECKING OIL PUMP - F2L 912 -

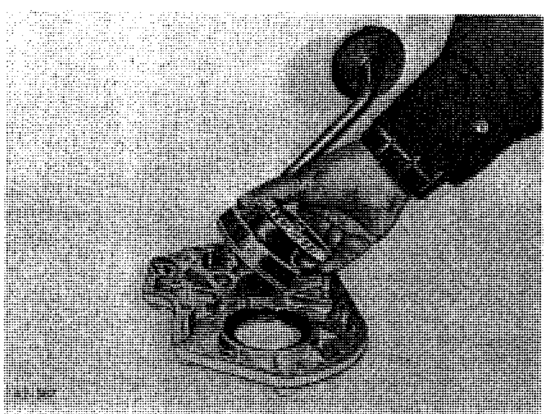
1. Remove oil pump from housing cover.
Fig. 8-117



8-118

801

2. Check axial play of impeller gear on drive shaft.
Fig. 8-118

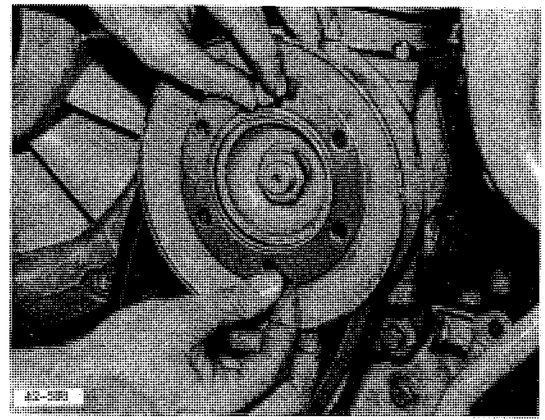


8-119

3. Mount oil pump to housing cover.
Fig. 119

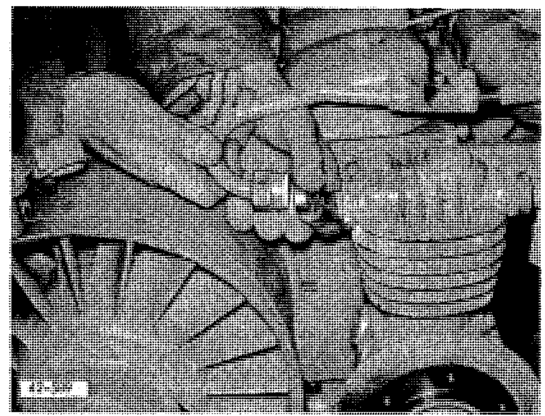
REMOVING, REFITTING AIR COMPRESSOR AND BRACKET

1. Remove outer half of V-belt pulley and take off V-belt.
Fig. 8-120



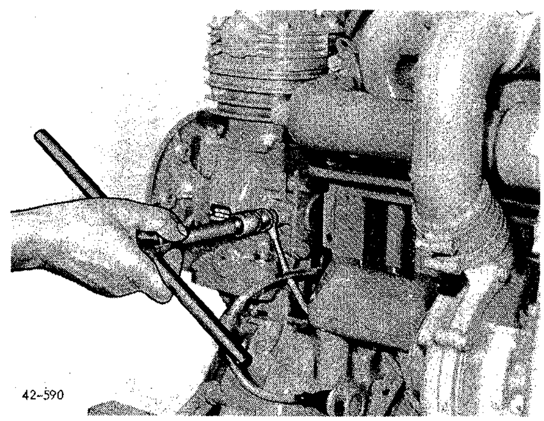
8-120

2. Detach suction line.
Fig. 8-121



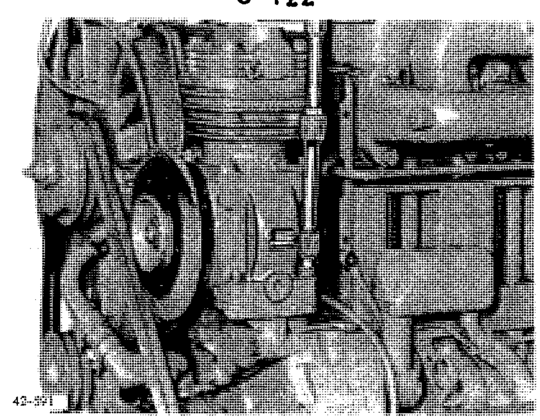
8-121

3. Screw off lube oil pressure line.
Fig. 8-122

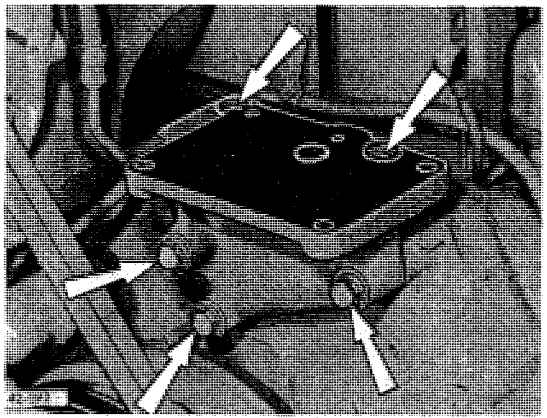


8-122

4. Remove air compressor.
Fig. 8-123

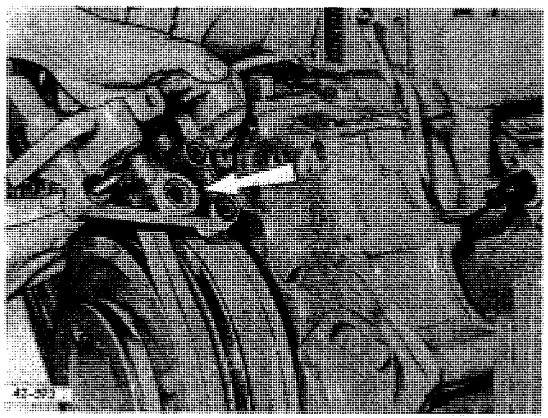


8-123



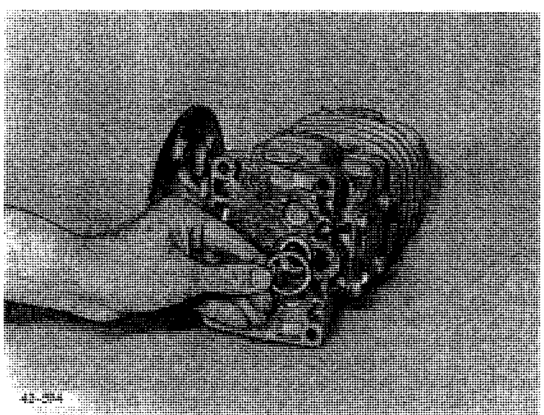
8-124

5. Remove bracket.
Fig. 8-124



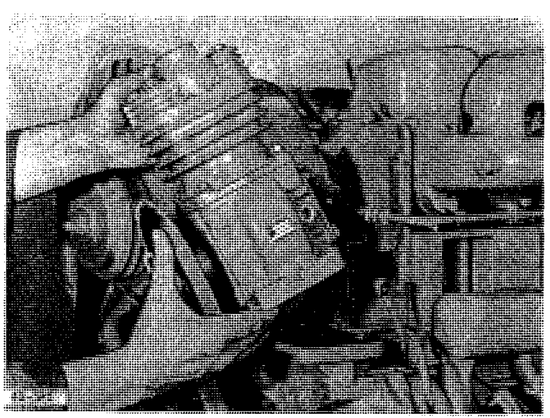
8-125

6. Mount bracket, after affixing O-seal.
Fig. 8-125



8-126

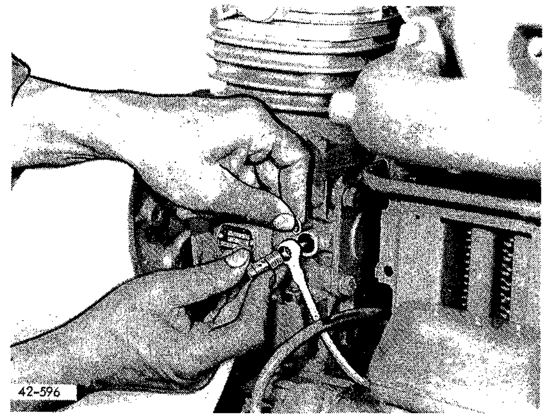
7. Affix O-seal on air compressor.
Fig. 8-126



8-127

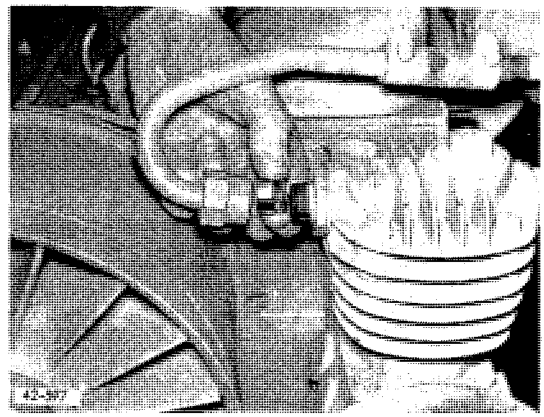
8. Mount air compressor. Tighten bolts.
Fig. 8-127

9. Mount lube oil pressure line c/w sealing rings.
Fig. 8-128



8-128

10. Connect suction line c/w sealing ring to air compressor.
Fig. 8-129

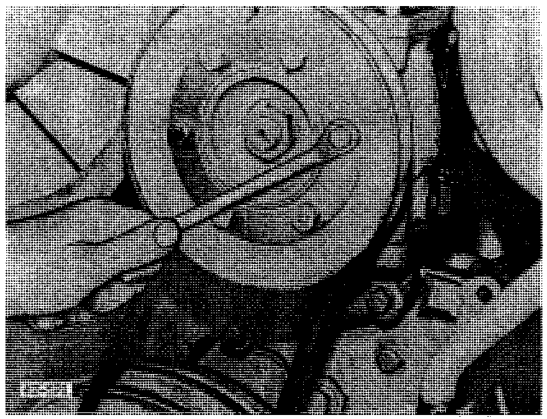


8-129

Mount V-belt - see Chapter 8, Page 36.

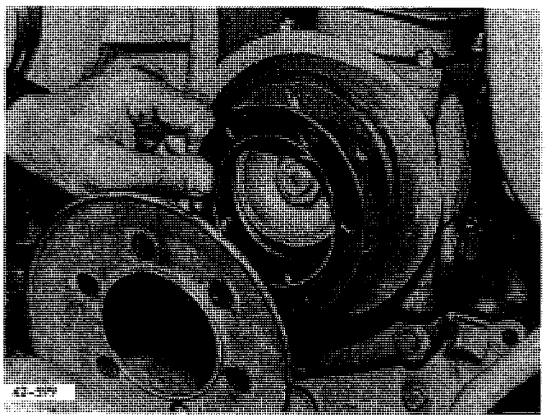
TENSIONING, RENEWING V-BELT FOR AIR COMPRESSOR

- ONE-GROOVE PULLEY -



8-130

1. Unscrew bolts. Remove outer half of V-belt pulley and take off V-belt.
Fig. 8-130

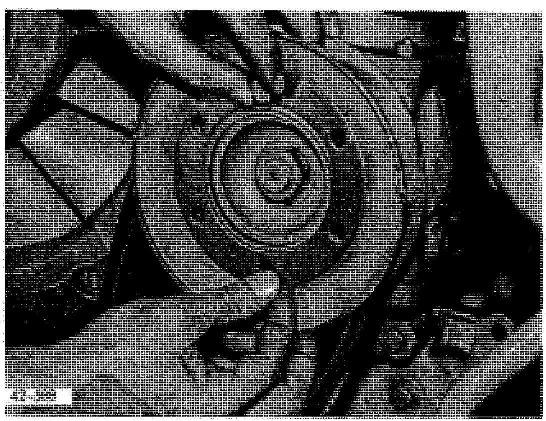


8-131

2. The V-belt tension is increased by remove of shims.

Note:

Removed shims are to be placed on outer side of V-belt pulley-half.
Fig. 8-131

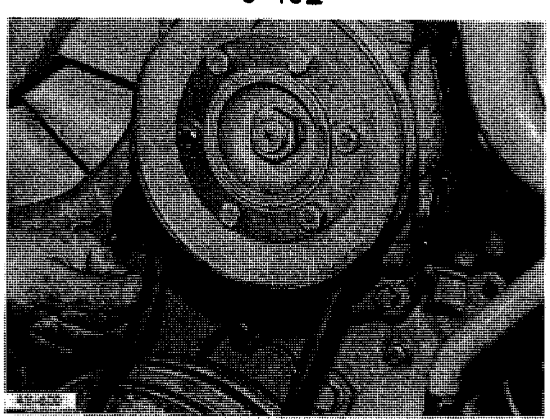


8-132

3. Place V-belt on shoulder. Mount outer half of V-belt pulley with removed shims added outside.

Note:

Tighten bolts uniformly while continually turning the engine.
Fig. 8-132



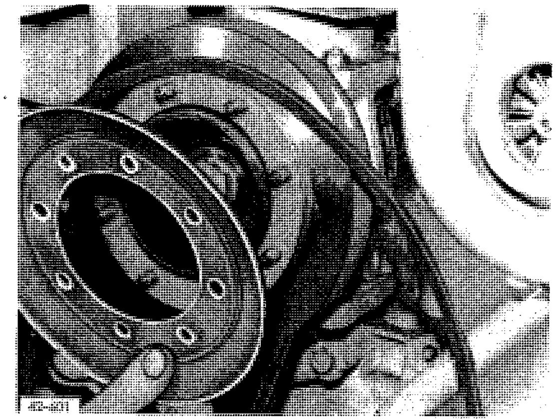
8-133

4. Check V-belt tension. When pressed with the thumb midway between the pulleys, the V-belt should deflect inwards by about 10 mm.

If necessary, repeat tensioning procedure.
Fig. 8-133

- TWO-GROOVE PULLEY -

1. For tensioning the outer V-belt, screw off nuts and take off outer half of V-belt pulley. Fig. 8-134

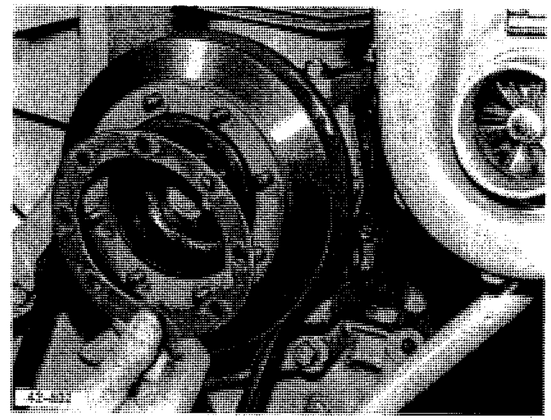


8-134

2. Remove one shim from between outer pulley-half and intermediate piece.

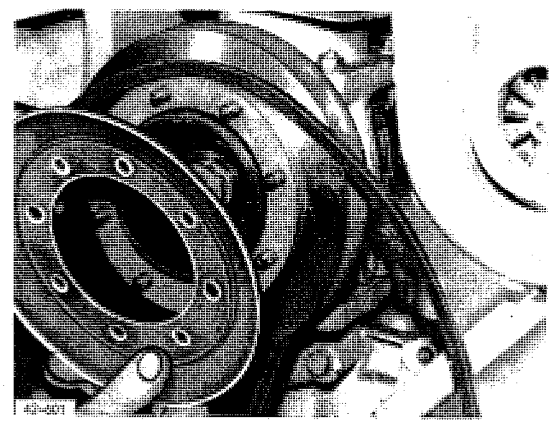
Note:

Place removed shim on outer side of V-belt pulley-half. Fig. 8-135



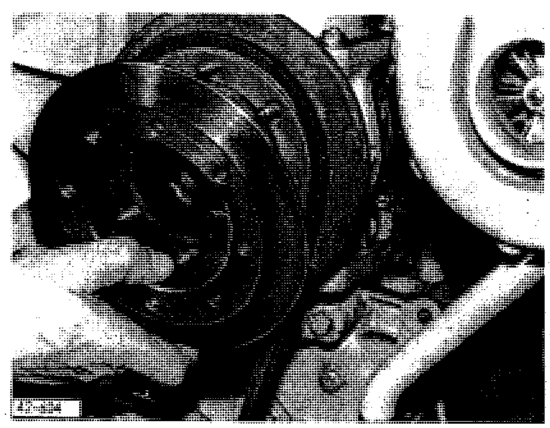
8-135

3. Mount outer half of V-belt pulley with removed shim added outside. Tighten nuts while continually turning the engine. Fig. 8-136

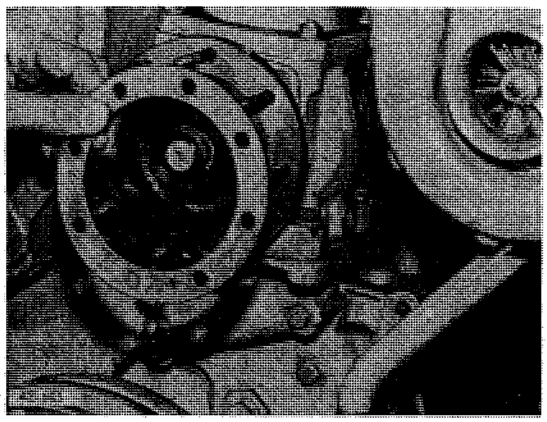


8-136

4. For tensioning the inner V-belt, remove components in following sequence:
Outer half of V-belt pulley.
Shims.
Intermediate piece (see photo).
Shims.
V-belt.
Inner half of V-belt pulley.
Fig. 8-137

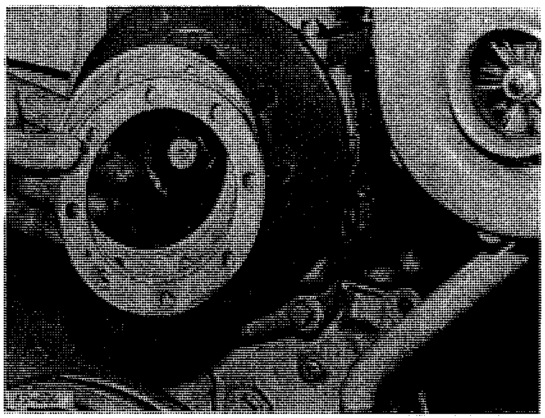


8-137



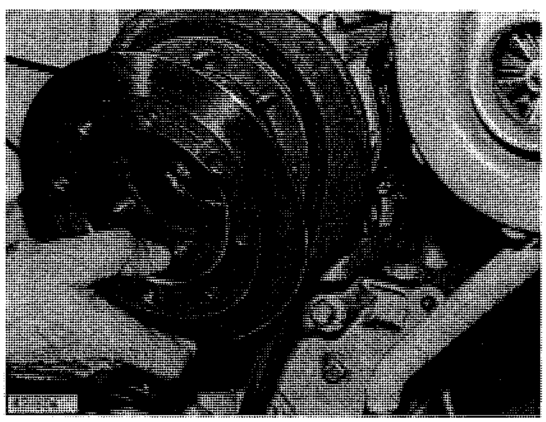
8-138

5. Place one shim on hub body.
Fig. 8-138



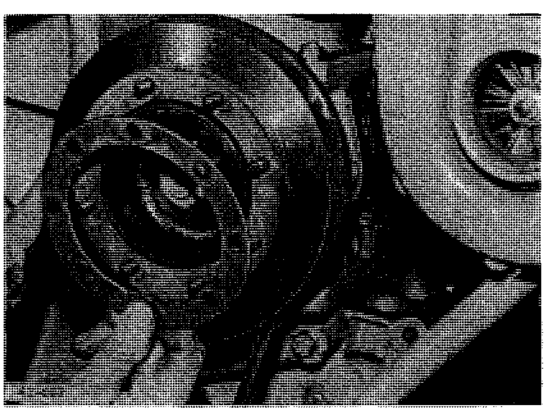
8-139

6. Place on inner half of V-belt pulley together with remaining shims.
Fig. 8-139



8-140

7. Place on inner V-belt and intermediate piece.
Fig. 8-140

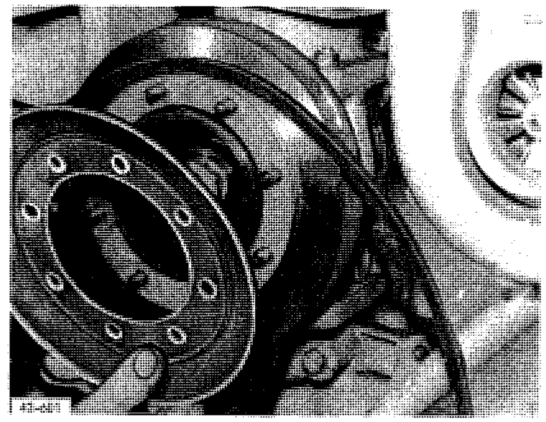


8-141

8. Place on shims.
Fig. 8-141

9. Place on outer V-belt. Mount outer half of V-belt pulley and tighten nuts uniformly while continually turning the engine. Check vee belt tension.
Fig. 8-142

If necessary, repeat tensioning procedure separately for each V-belt.



8-142

Index

9. Dismantling and Reassembling, Engine Complete - F2L 912 -

Page

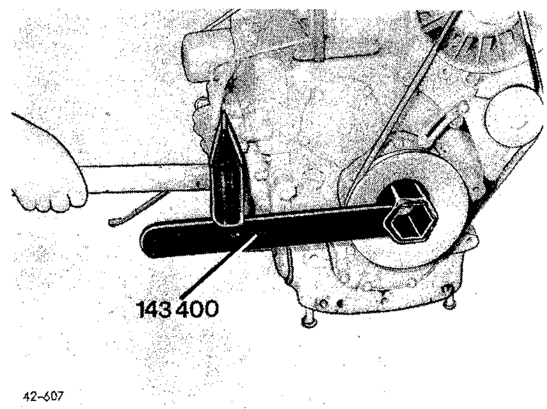
Dismantling and Reassembling, Engine Complete - as from 3-Cyl. Engines -

DISMANTLING ENGINE - F2L 912 -

Special tools required:

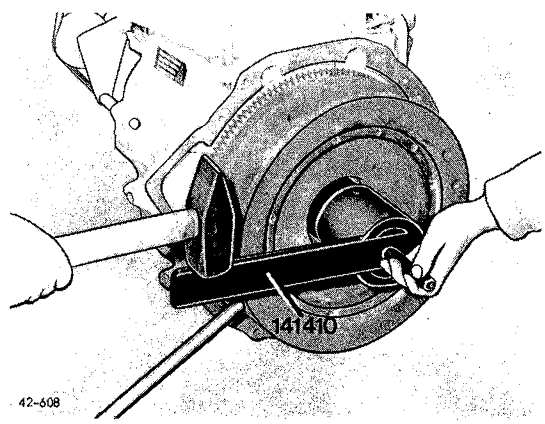
Extractor for injector No. 110030
Screw fitting for
injector .... No. 110050
Socket wrench .... No. 120040
Socket wrench .... No. 131500
Pipe-head wrench ..... No. 131540
Puller .... No. 141000
Press-in device ...... No. 141020
Hammering wrench ..... No. 141410
Retainer .... No. 143400
Extractor .... No. 150800

1. Undo nut for V-belt pulley, while counter-holding engine at flywheel.
Fig. 9-1



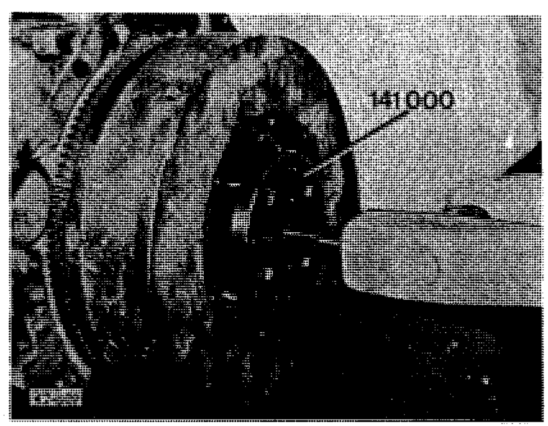
9-1

2. Undo flywheel nut.
Fig. 9-2

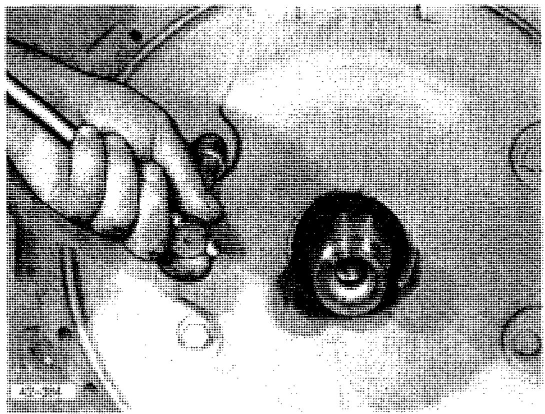


9-2

3. Fasten puller in position and tighten to stress. Loosen flywheel with jarring blow. Remove puller and flywheel.
Fig. 9-3

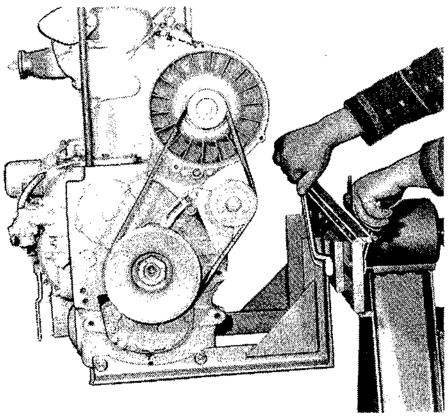


9-3



9-4

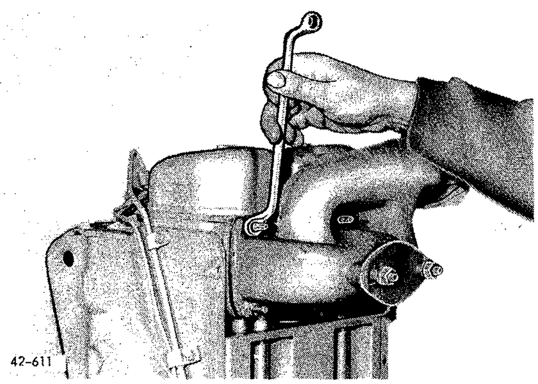
4. Remove mounting flange.
Fig. 9-4



42-610

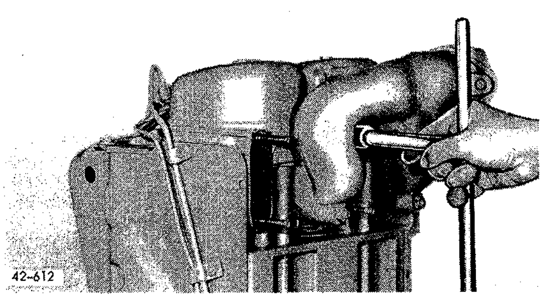
9-5

5. Fasten engine to assembly stand No. 6067. Drain oil.
Fig. 9-5



9-6

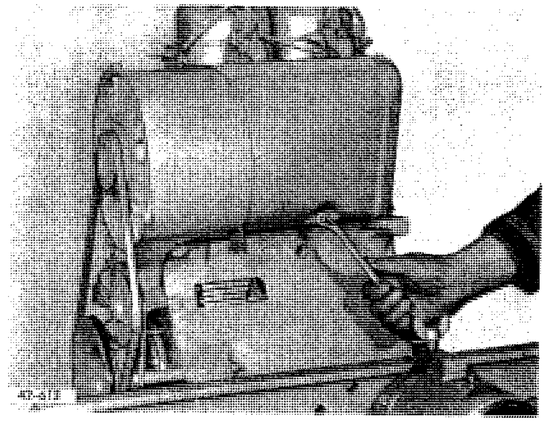
6. Remove exhaust manifold.
Fig. 9-6



9-7

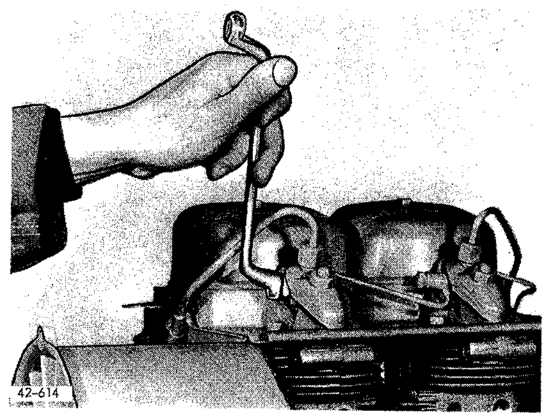
7. Remove intake manifold.
Fig. 9-7

8. Remove air cowling.
Fig. 9-8



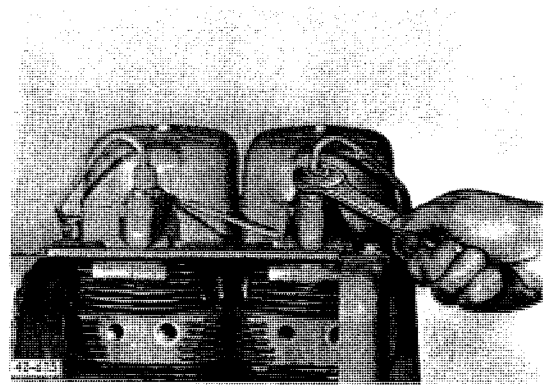
9-8

9. Detach backleakage line.
Fig. 9-9



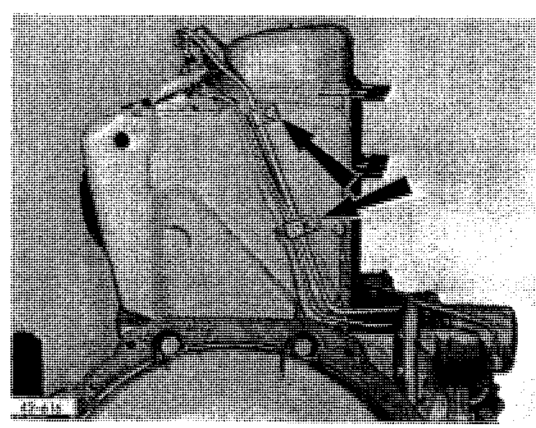
9-9

10. Detach injection lines.
Fig. 9-10

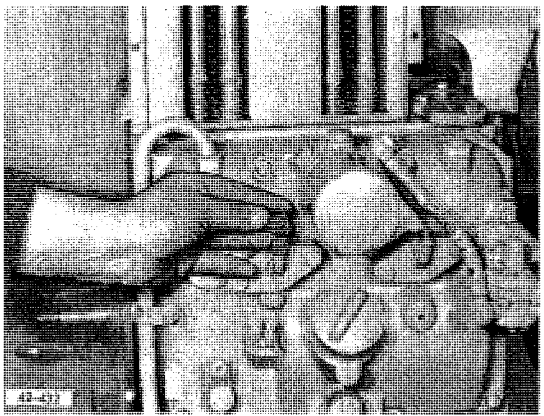


9-10

11. Undo pipe clips at flywheel end and at blower end.
Fig. 9-11

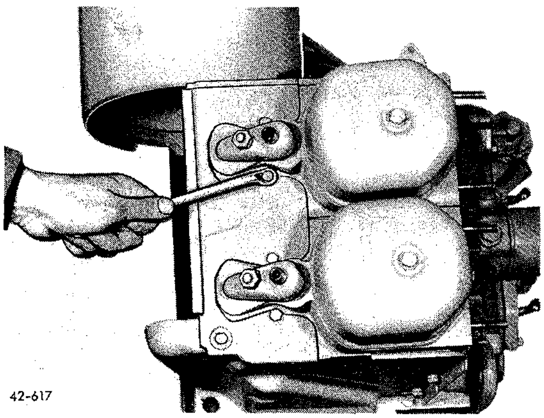


9-11



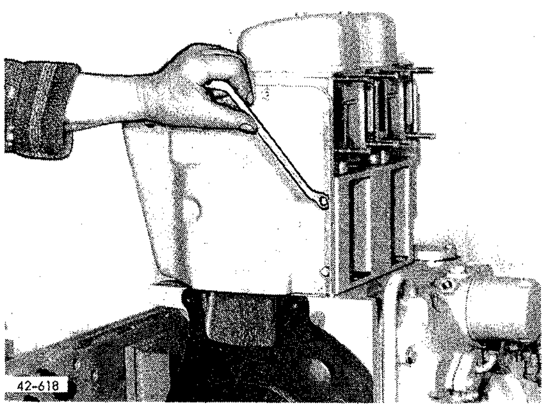
9-12

12. Close pressure connections.
Fig. 9-12



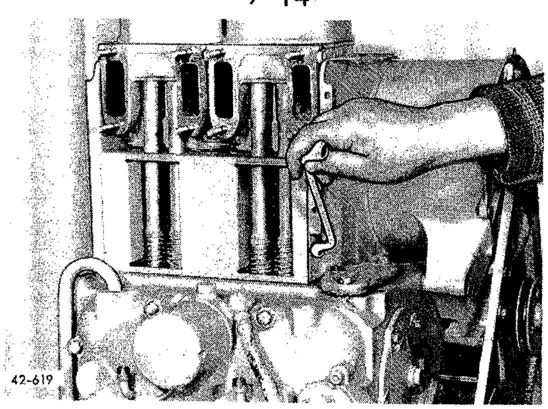
9-13

13. Remove upper cover plate.
Fig. 9-13



9-14

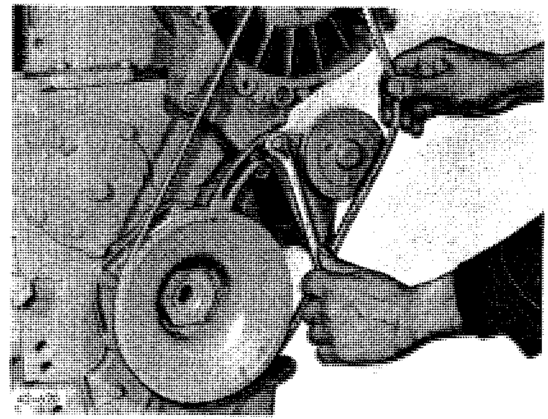
14. Remove stay plate at flywheel end.
Fig. 9-14



9-15

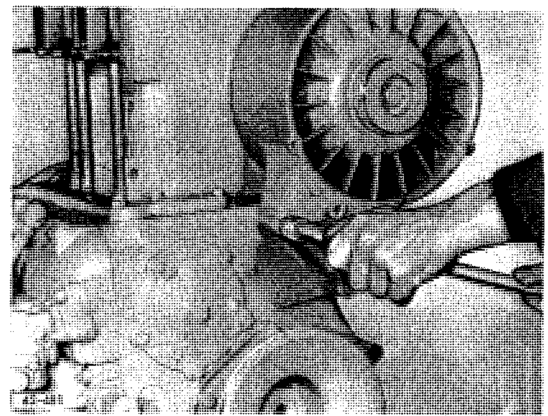
15. Remove cover plate on air discharge side.
Fig. 9-15

16. Loosen V-belt tensioning pulley and take off V-belt.
Fig. 9-16



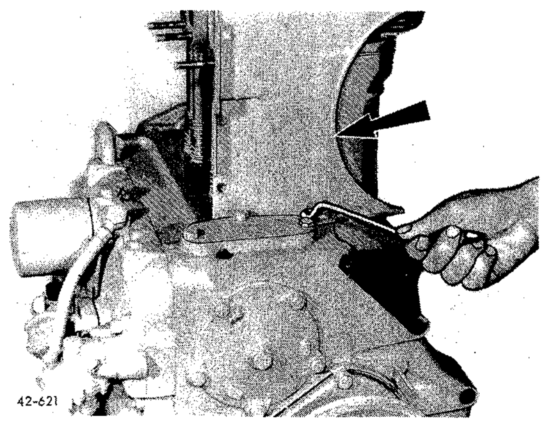
9-16

17. Remove cooling air blower.
Fig. 9-17



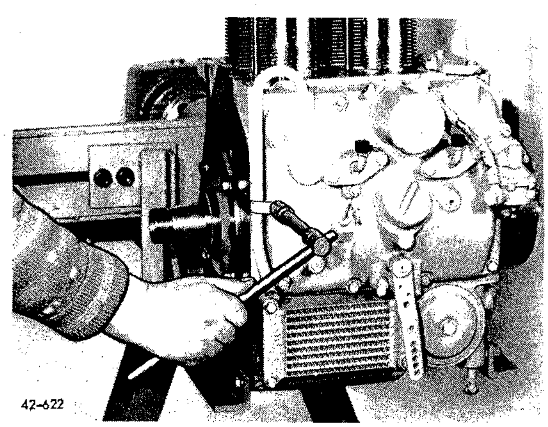
9-17

18. Remove stay plate at blower end.
Fig. 9-18

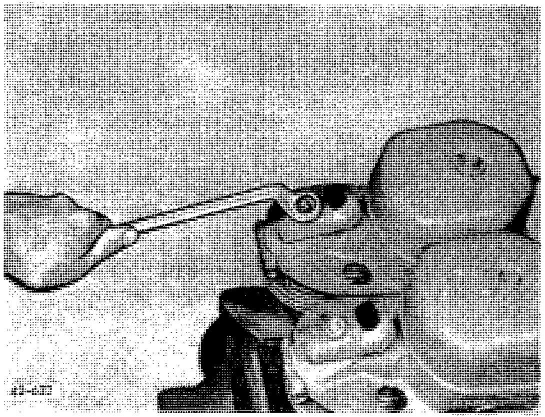


9-18

19. Remove injection pump cover.
Fig. 9-19

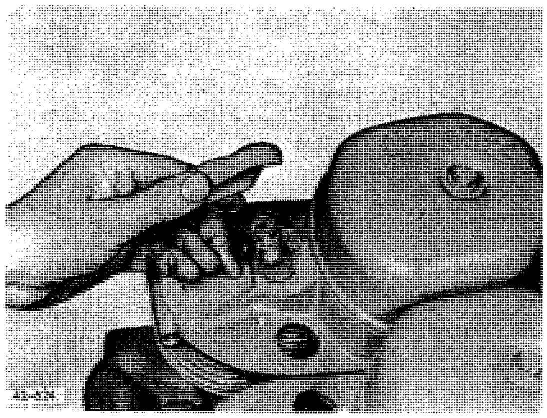


9-19



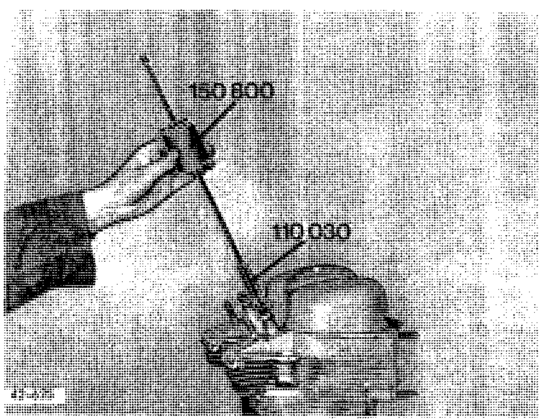
9-20

20. Undo fastening of injector.
Fig. 9-20



9-21

21. REmove clamping bridge.
Fig. 9-21

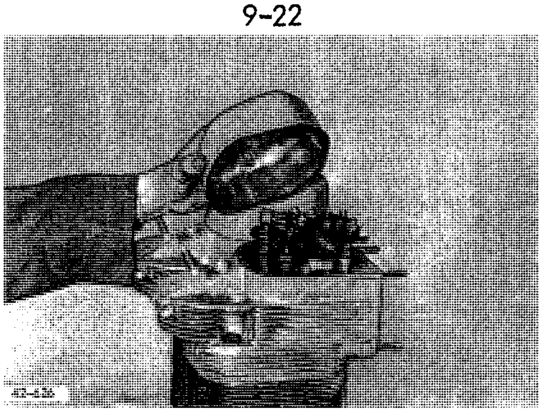


9-22

22. Remove injector by means of extractor.

Note:

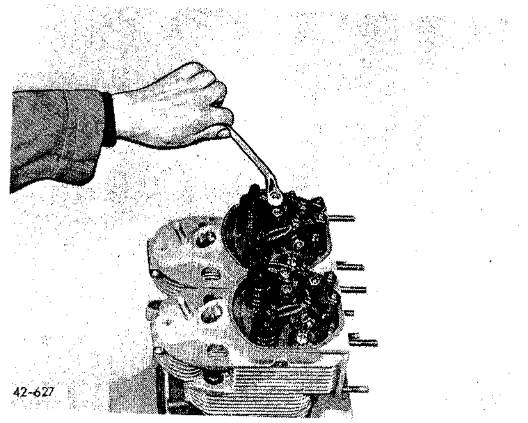
In the case of lateral connection of the injection line, use the screw fitting No. 110050 together with extractor No. 150800.
See Chapter 7.
Fig. 9-22



9-23

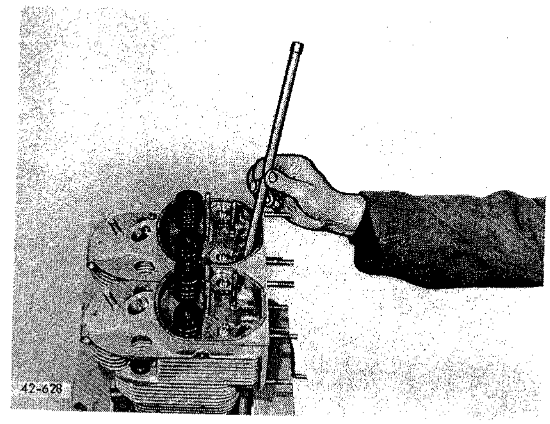
23. Remove rocker chamber covers.
Fig. 9-23

24. Remove rocker brackets.
Fig. 9-24



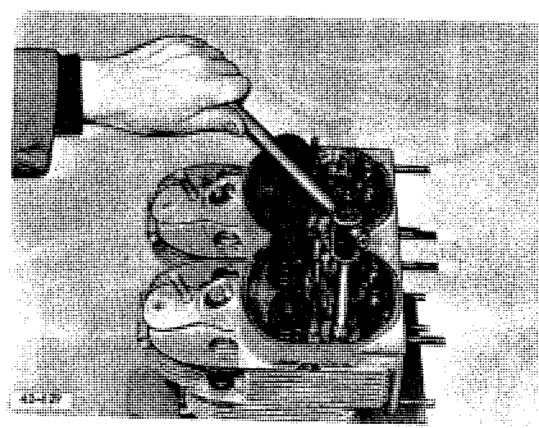
9-24

25. Take out pushrods.
Fig. 9-25



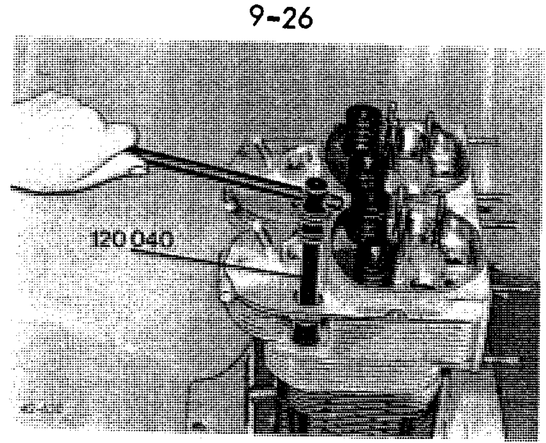
9-25

26. Screw out plugs.
Fig. 9-26

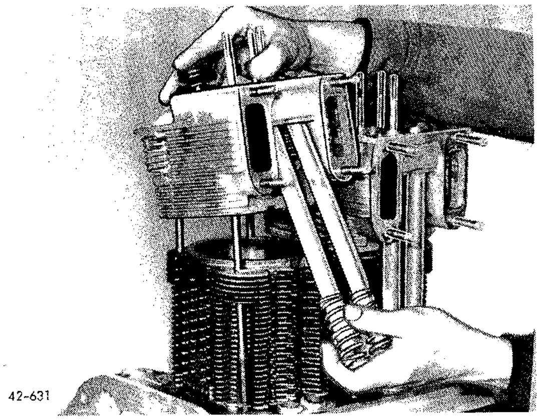


9-26

27. Loosen cylinder head bolts in stages, cross-wise.
Fig. 9-27

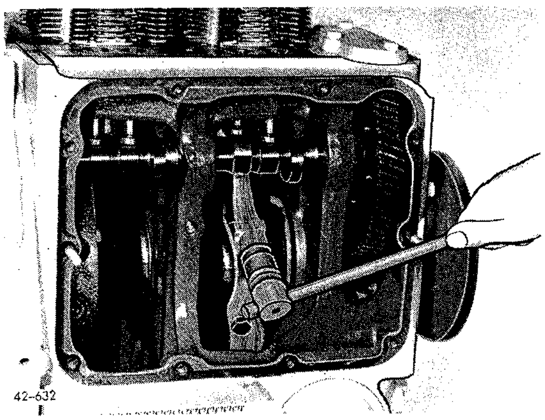


9-27



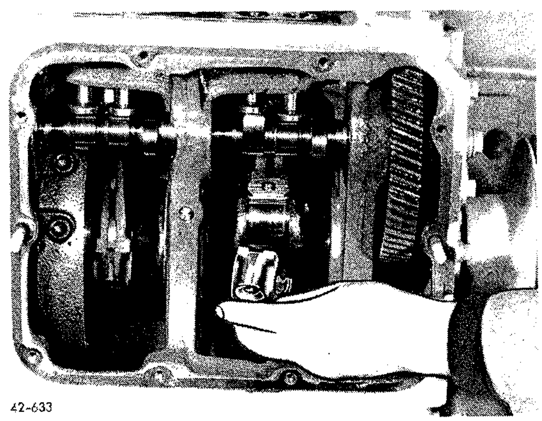
9-28

28. Take off cylinder heads and pushrods cover tubes.
Fig. 9-28



9-29

29. Screw out big-end bearing bolts.
Fig. 9-29

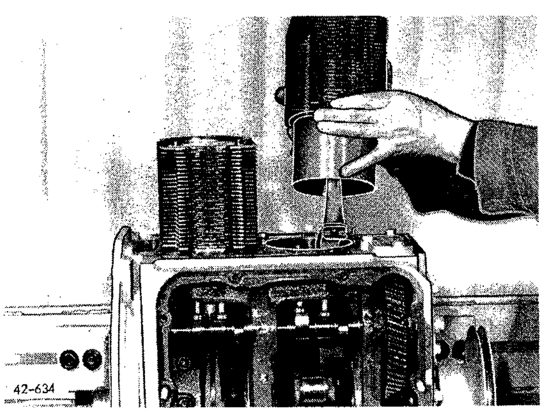


9-30

30. Slacken and remove bearing cap.

Note:

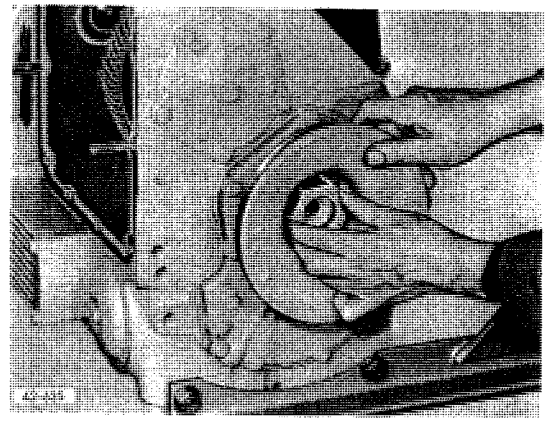
Take care not to damage bearing shells.
Fig. 9-30



9-31

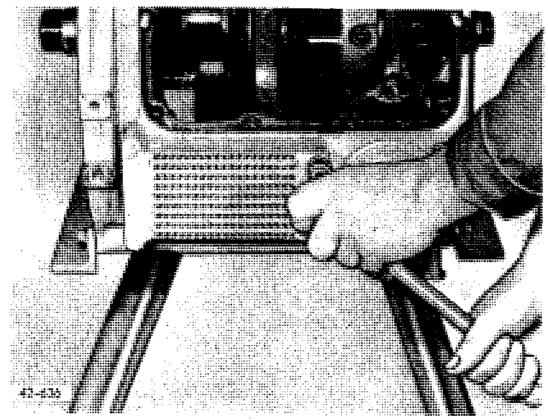
31. Lift cylinder together with piston and connecting rod out of crankcase.
Fig. 9-31

32. Screw off nut for V-belt pulley. Remove pulley.
Fig. 9-32



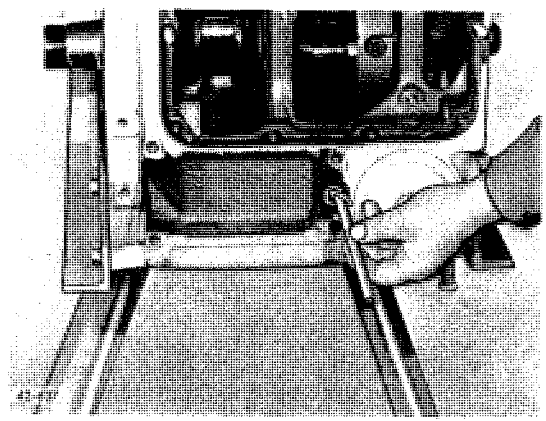
9-32

33. Remove oil cooler.
Fig. 9-33



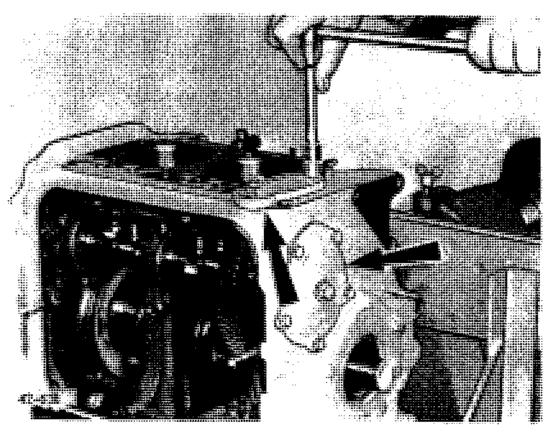
9-33

34. Take out oil pipe.
Fig. 9-34

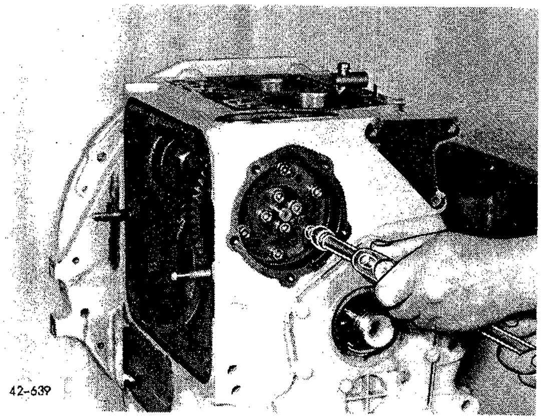


9-34

35. Remove upper and front camshaft covers.
Fig. 9-35

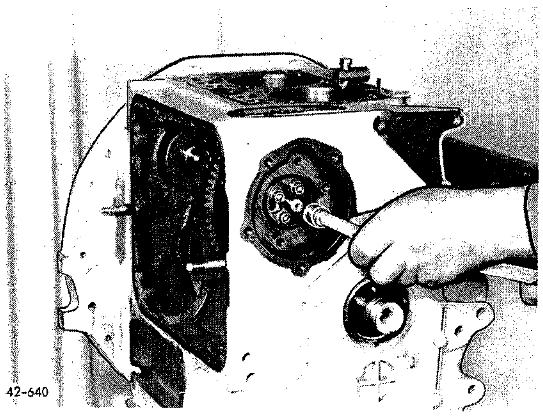


9-35



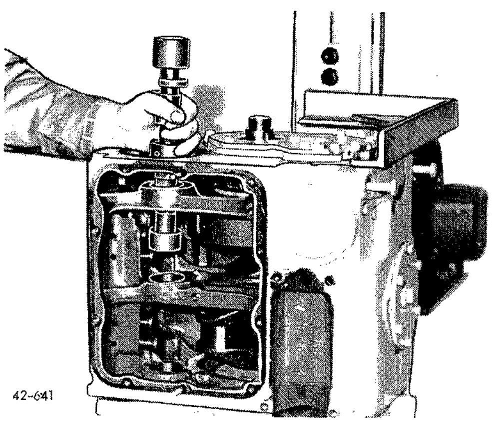
9-36

36. Remove eccentric ring on camshaft gear.
Fig. 9-36



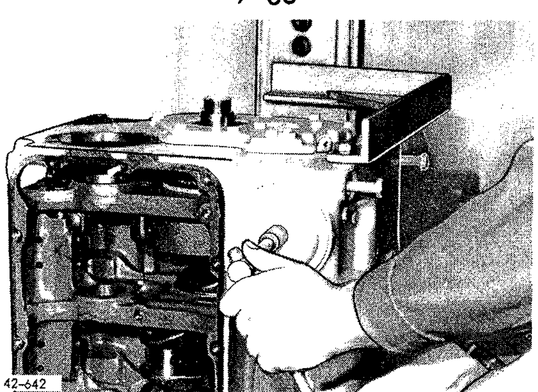
9-37

37. Screw out bolts for camshaft gear.
Fig. 9-37



9-38

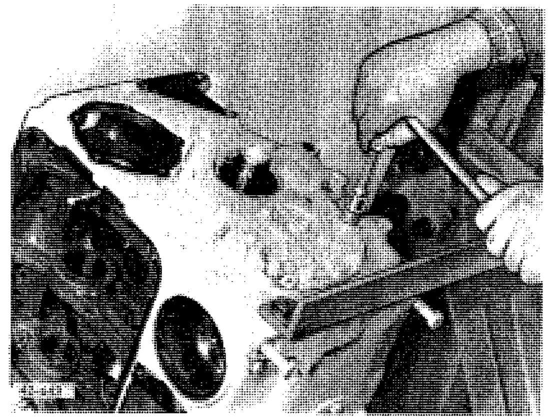
38. Take out camshaft and tappets.
Fig. 9-38



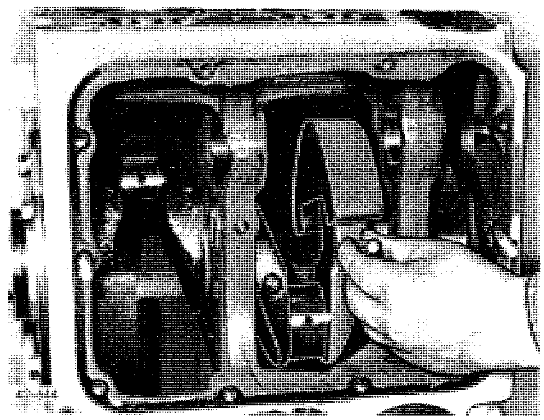
9-39

39. Remove oil filter.
Fig. 9-39

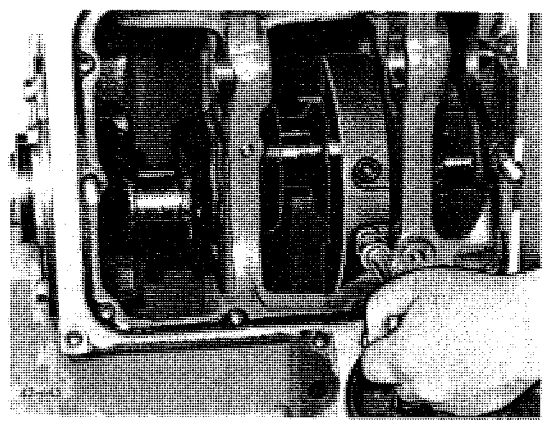
40. Remove front cover with oil pump.
Fig. 9-40


9-40

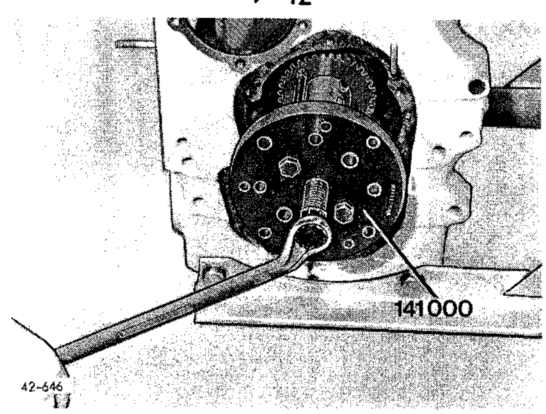
41. Mark balance weights relative to crankshaft.
Fig. 9-41


9-41

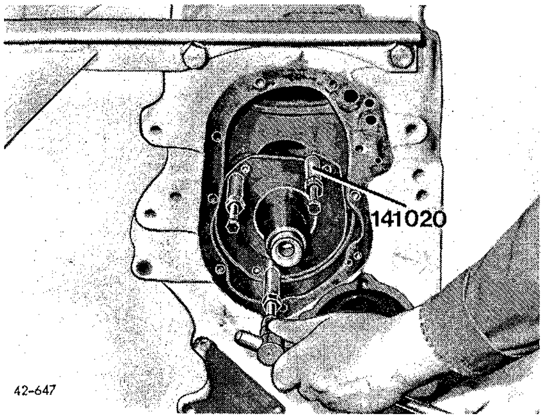
42. Remove balance weights.
Fig. 9-42


9-42

43. Pull off crankshaft gear.
Fig. 9-43

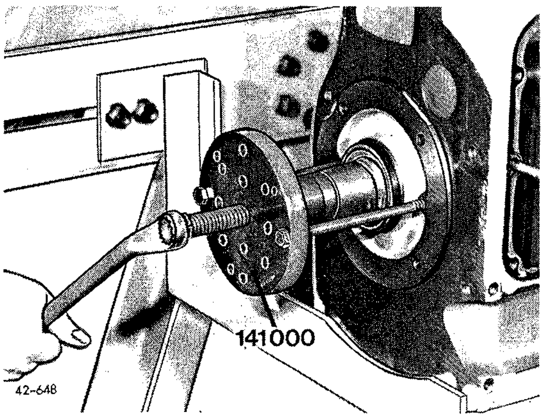


9-43



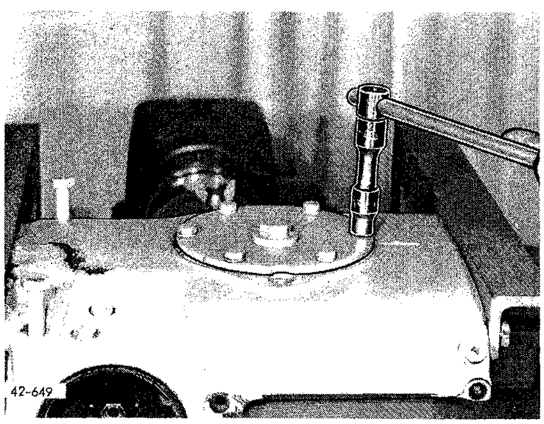
9-44

44. Screw out bolts at front endshield. Push off endshield.
Fig. 9-44



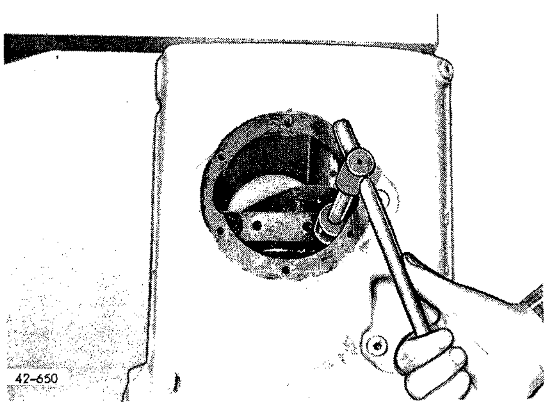
9-45

45. Screw out bolts at rear endshield. Pull off endshield.
Fig. 9-45



9-46

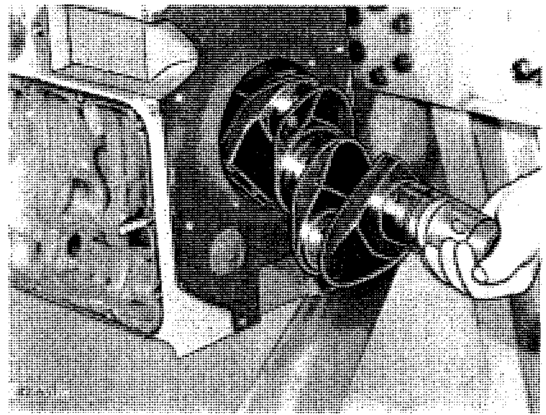
46. Remove bottom crankcase cover.
Fig. 9-46



9-47

47. Screw out bolts at central main bearing cap. Remove bearing cap.
Fig. 9-47

48. Remove crankshaft towards flywheel end.
Fig. 9-48



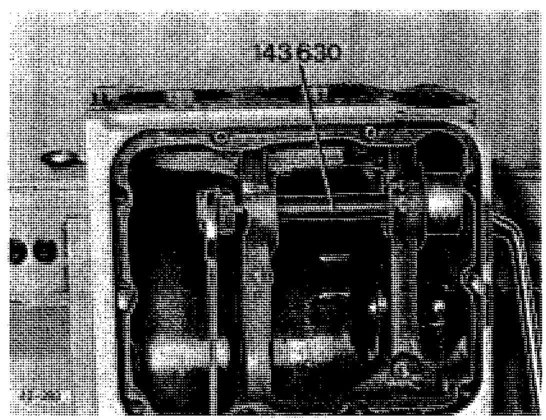
9-48

REASSEMBLING ENGINE
- Driving Mechanism -

Special tools required:

Degree gauge .... No. 101910
Press-in device ...... No. 141010
Press-in device ...... No. 141020
Press-in device ...... No. 143610
Extractor/Puller ..... No. 143630

1. Install bearing bush of front camshaft bore puller device. For details, see Chapter 4.
Fig. 9-49



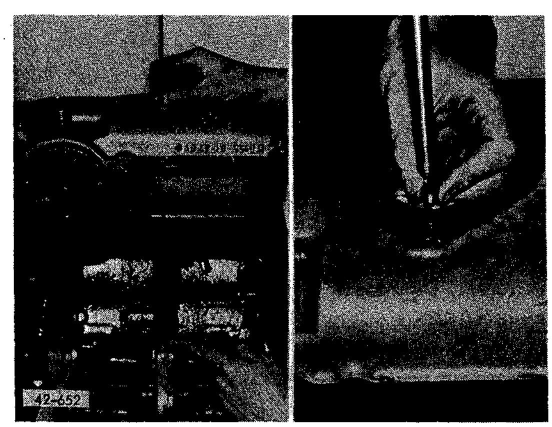
9-49

2. Check presence of oil dosing plug in oil duct of central bearing web.

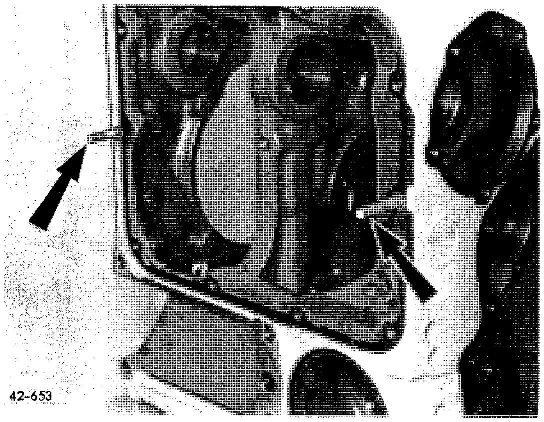
Note:

A 3 mm-gauge wire may not pass through down to the camshaft bore (photo, left).

3. If absent, drive in oil dosing plug with dosing bore facing inwards (photo, right).
Fig. 9-50

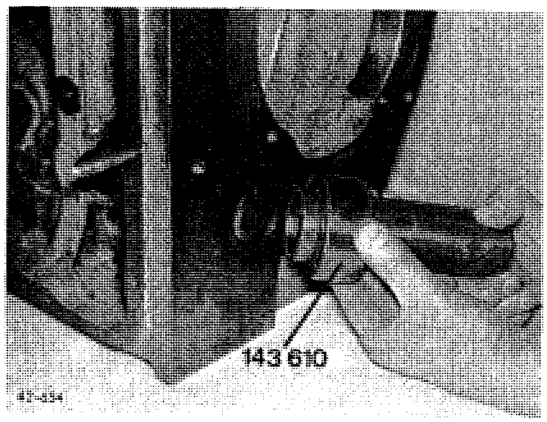


9-50



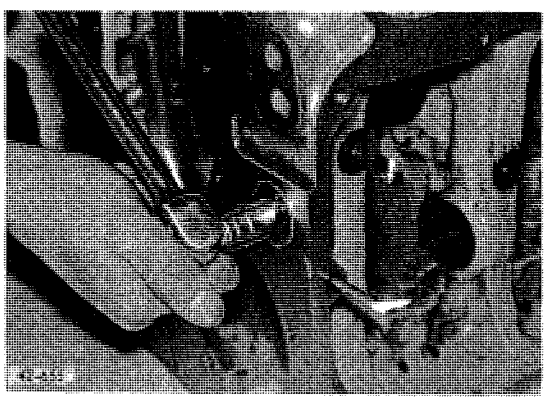
9-51

4. Check the two studs for injection pump cover. Renew damaged or missing studs.
Fig. 9-51



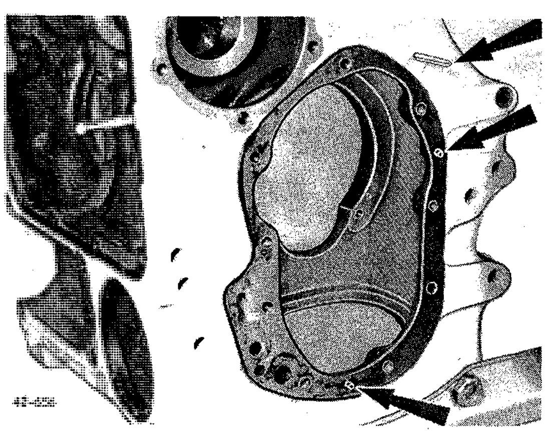
9-52

5. Fit camshaft bore cover at flywheel end with sealing compound. Drive in with press-in device.
Fig. 9-52



9-53

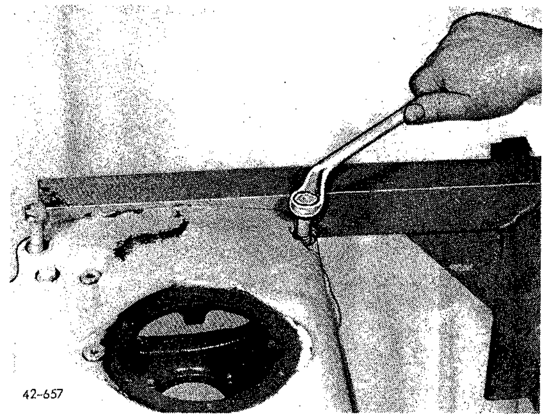
6. Screw in slotted plug at front end with sealing compound.
Fig. 9-53



9-54

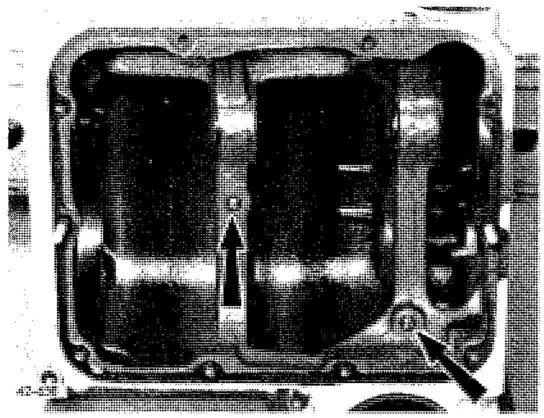
7. Check dowel sleeves. Renew damaged or missing sleeves.
Fig. 9-54

8. Screw down two bolts, M 10 x 60.
Fig. 9-55



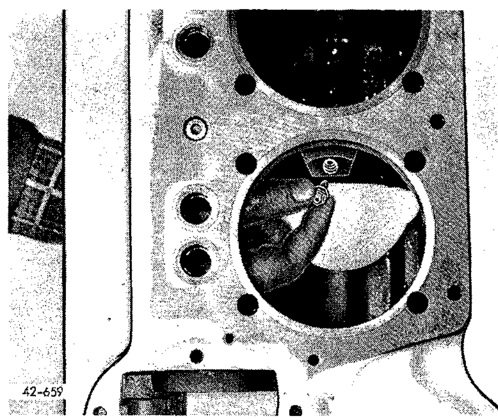
9-55

9. Insert two plugs with sealing compound at the two bearing webs, and secure.
Fig. 9-56



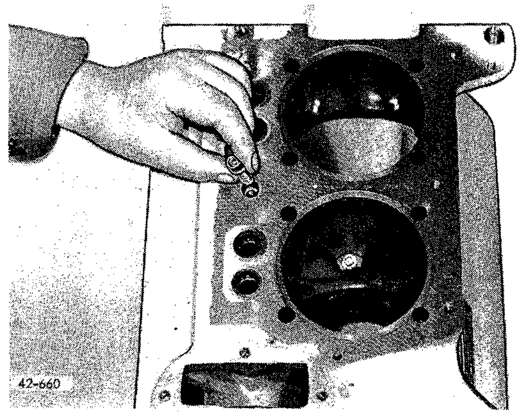
9-56

10. On both sides of the central bearing web, screw in a piston cooling nozzle c/w spring washer.
Fig. 9-57

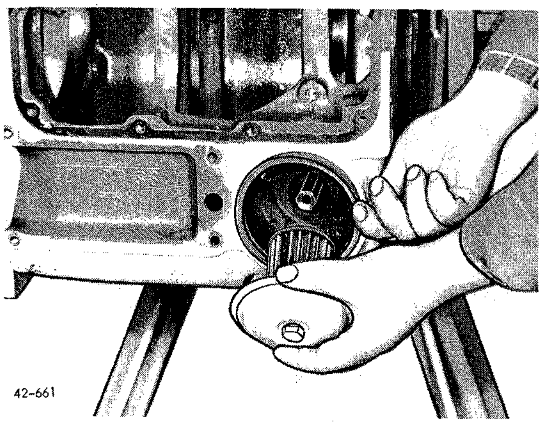


9-57

11. Screw in plug c/w sealing ring.
Fig. 9-58

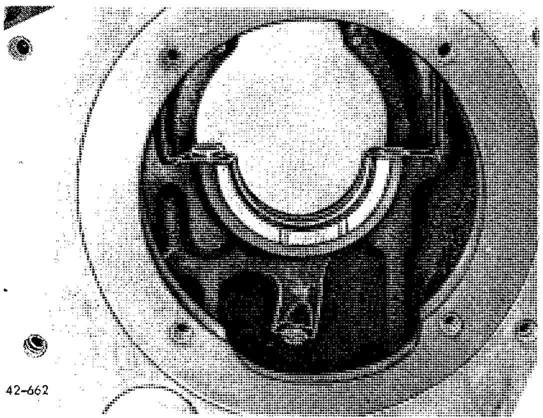


9-58



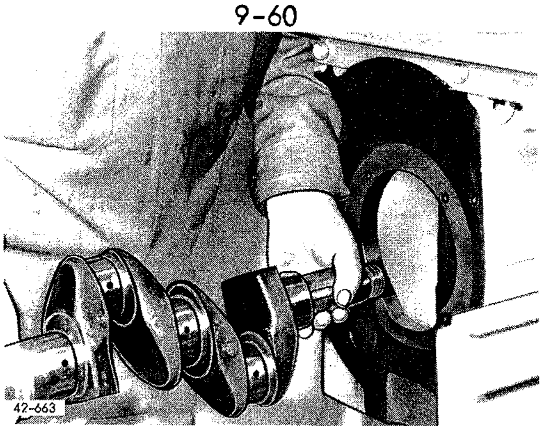
9-59

12. Place in gasket and mount lube oil filter with cover.
Fig. 9-59



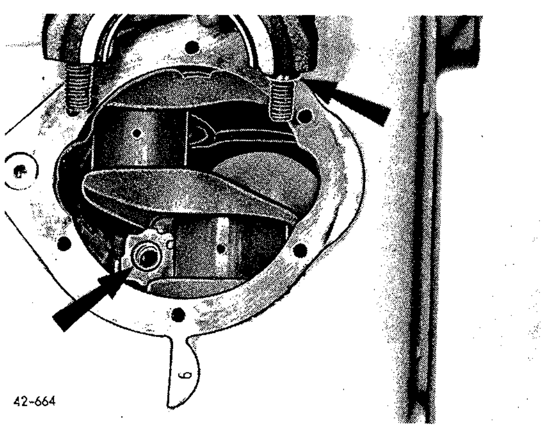
9-60

13. Place in bearing shell of central bearing. Affix stop rings with grease at bearing web and bearing cap.
Fig. 9-60



9-61

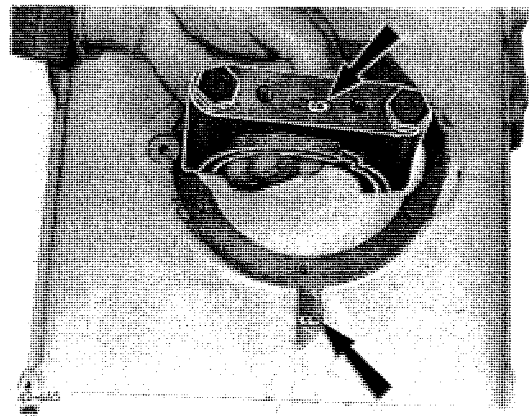
14. Oil central main bearing journal. Place in crankshaft from flywheel.
Fig. 9-61



9-62

15. Check presence of the dowel sleeves at bearing web and bearing cap.
Fig. 9-62

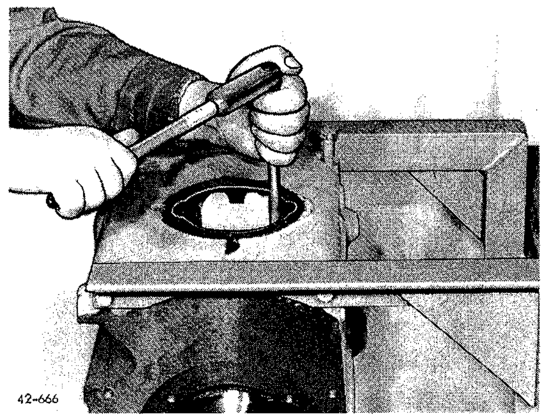
16. Install bearing cap, making sure that identification marking of bearing cap corresponds with that of crankcase.
Fig. 9-63



9-63

17. Pre-load main bearing bolts as specified.
Fig. 9-64

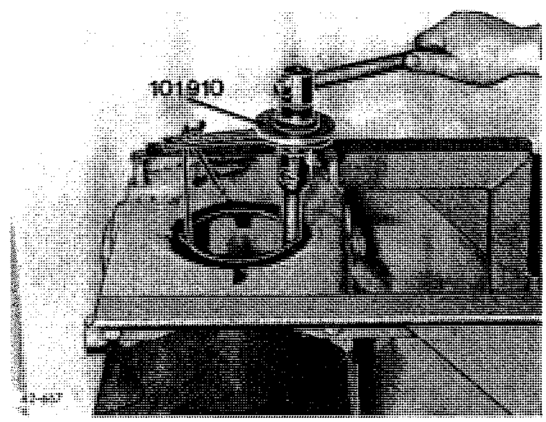
904



9-64

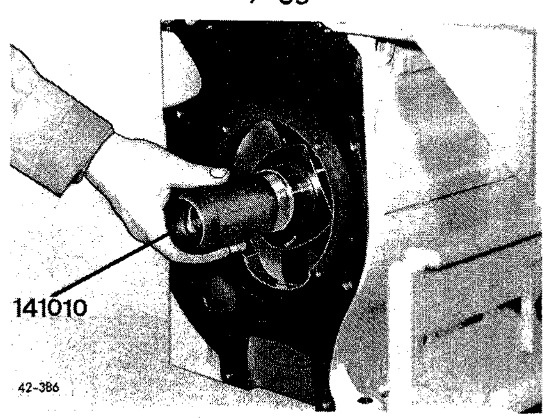
18. Finally tighten main bearing bolts as specified.
Fig. 9-65

904

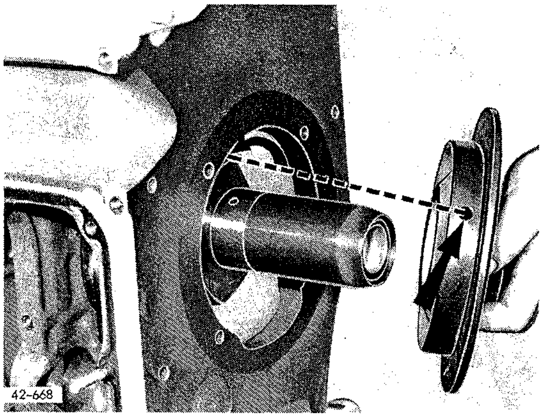


9-65

19. Push guide bush of press-in device over end of crankshaft and apply some oil.
Fig. 9-66

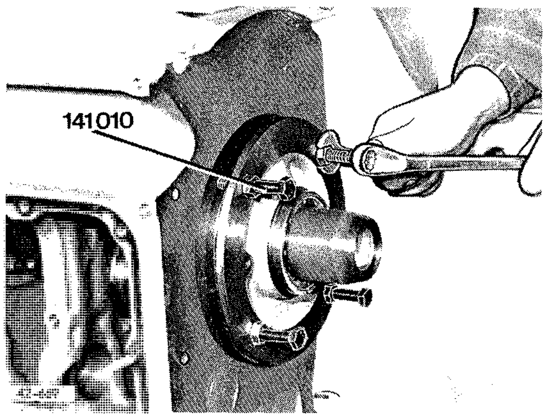


9-66



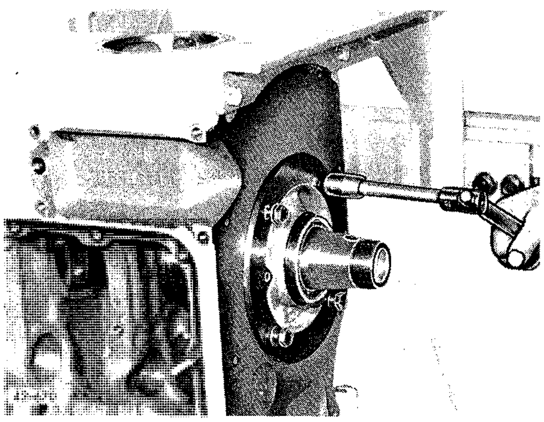
9-67

20. Oil sealing lip of shaft seal. Place on preassembled endshield (see Chapter 4) c/w new gasket. The oil bores of endshield and crankcase must coincide.
Fig. 9-67



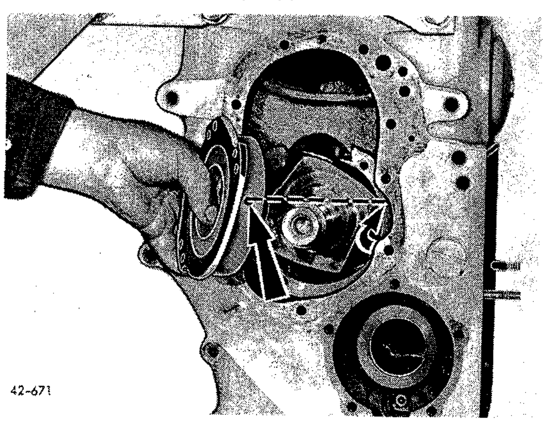
9-68

21. Using the press-in device, press endshield uniformly (cross-wise) into place.
Fig. 9-68



9-69

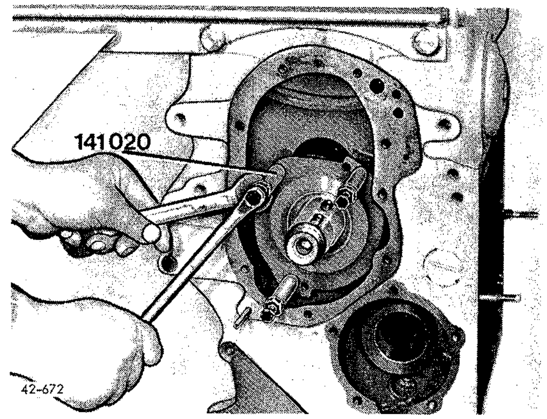
22. Remove press-in device. Insert fastening bolts of endshield c/w washers and tighten uniformly (cross-wise).
Fig. 9-69



23. Oil front main bearing journal. Place on preassembled endshield (see Chapter 4), making sure that oil bores in endshield and in crankcase coincide.
Fig. 9-70

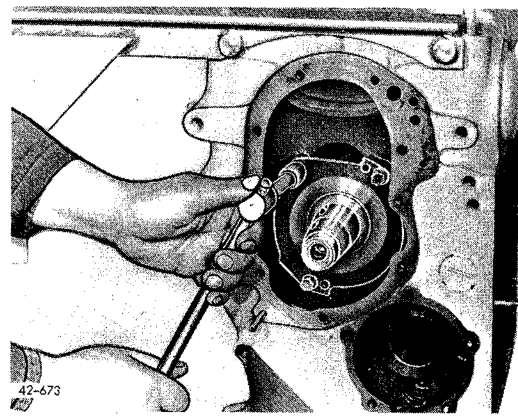
9-70

24. Mount endshield uniformly, without tilting, by means of the press-in device.
Fig. 9-71



9-71

25. Remove bolts of press-in device. Insert fastening bolts of endshield c/w washers and tighten up.
Fig. 9-72



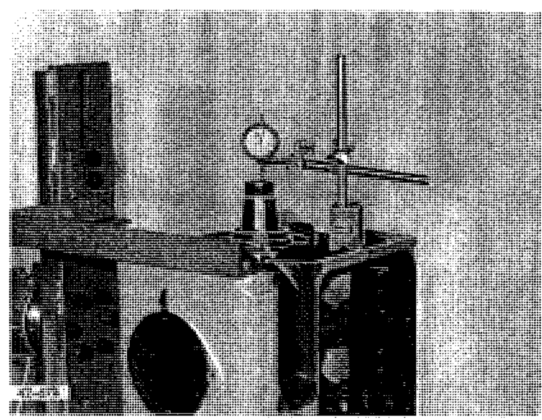
9-72

26. Mount magnetic stand with dial gauge. Measure end float of crankshaft.

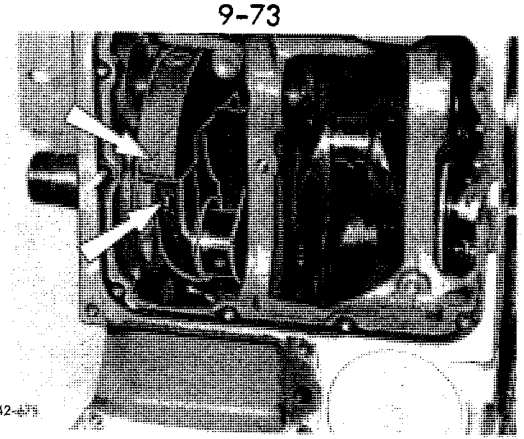
575

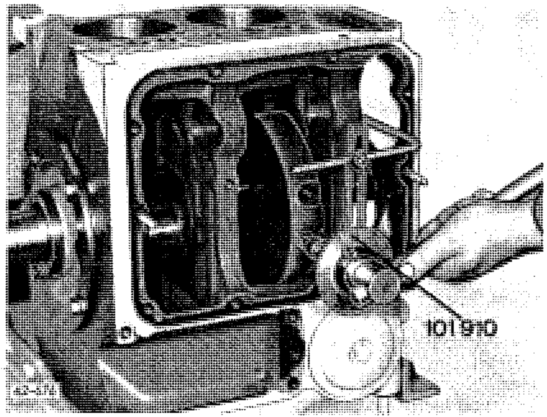
Note:

Correct the end float by using stop rings of appropriate thickness.
Fig. 9-73


9-73

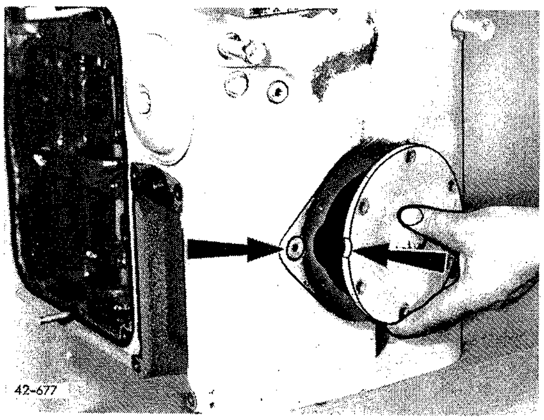
27. Mount balance weights onto crankshaft, paying attention to marking.
Fig. 9-74


9-74



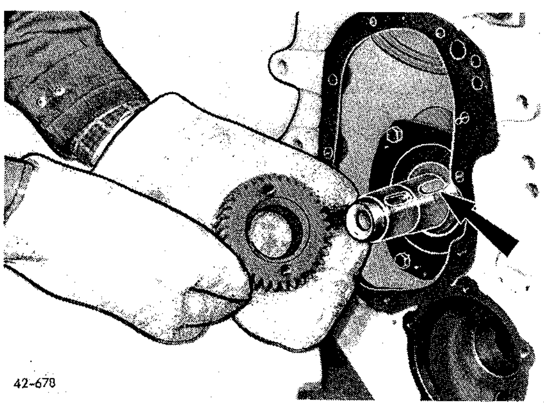
9-75

28. Pre-load and tighten balance weight bolts as specified.
Fig. 9-75



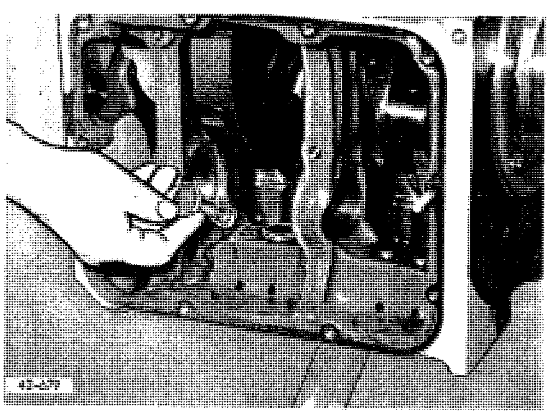
9-76

29. Mount bottom crankcase cover (c/w gasket) the correct way round.
Fig. 9-76



9-77

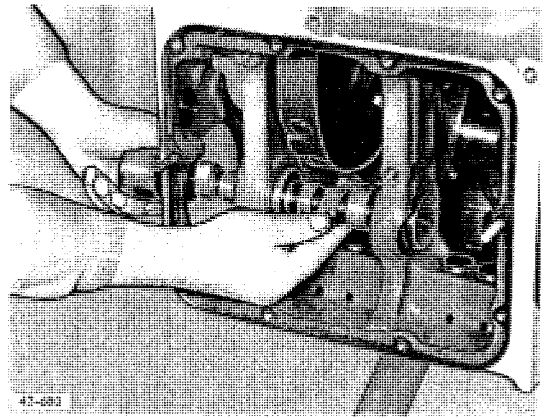
30. Insert key. Heat crankshaft gear to 100° C and push on with chamfer facing towards crankshaft.
Fig. 9-77



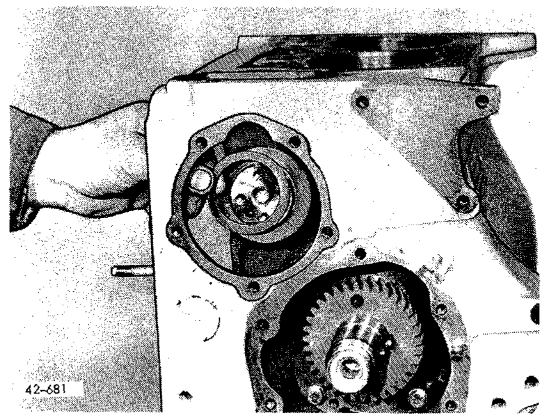
9-78

31. Oil tappets and insert.
Fig. 9-78

32. Oil camshaft journals. Introduce camshaft into bearing bores.
Fig. 9-79

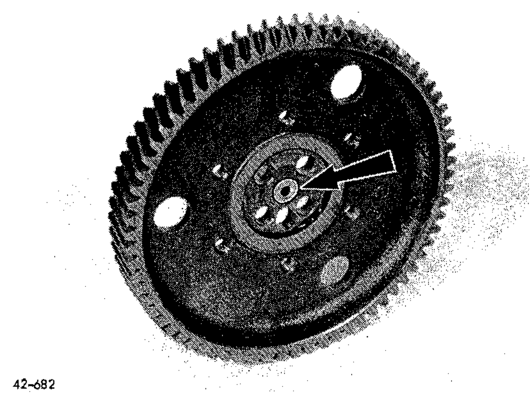

9-79

33. Place stop washer on camshaft.
Fig. 9-80



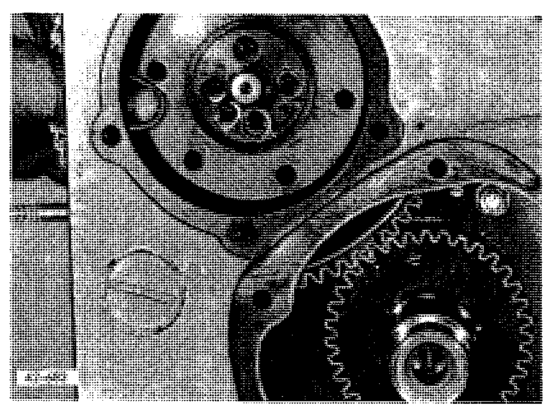
9-80

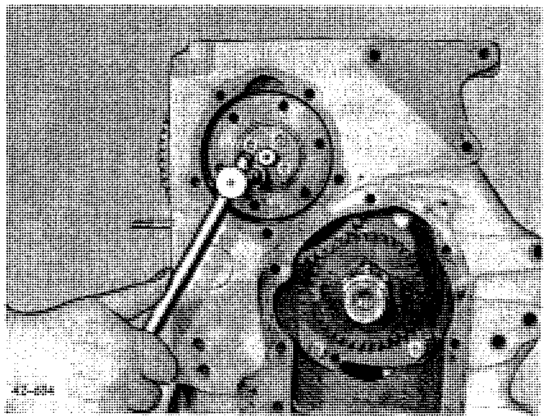
34. The counter bolt of camshaft gear must be flush with contact surface for camshaft.
Fig. 9-81



9-81

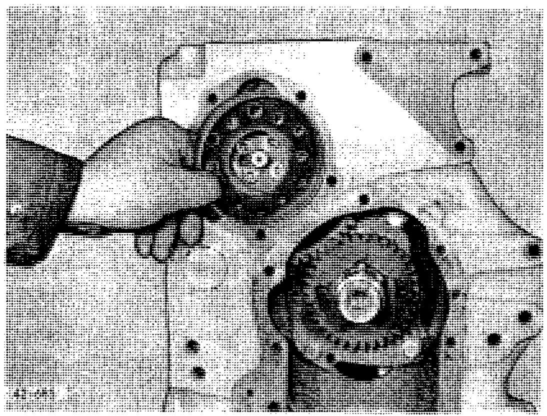
35. Position camshaft gear in accordance with markings, and mount.
Fig. 9-82


9-82



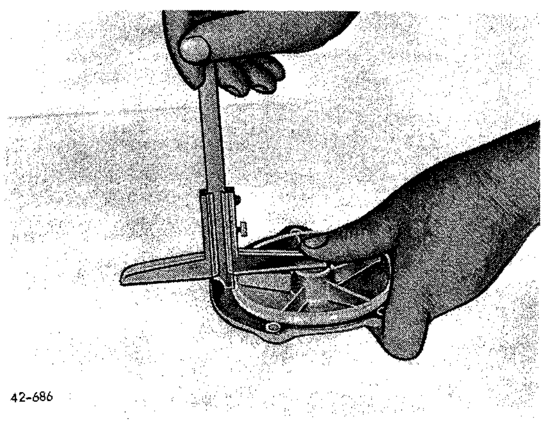
9-83

36. Tigthen fastening bolts of camshaft gear as specified.
Fig. 9-83



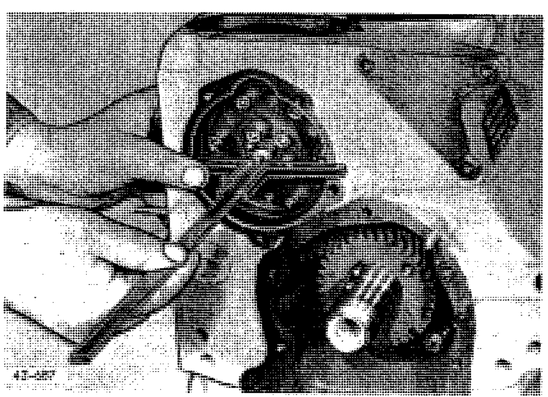
9-84

37. Mount eccentric ring on camshaft gear.
Fig. 9-84



9-85

38. Measure at camshaft cover the overhang of butting face relative to sealing surface with gasket.
Fig. 9-85



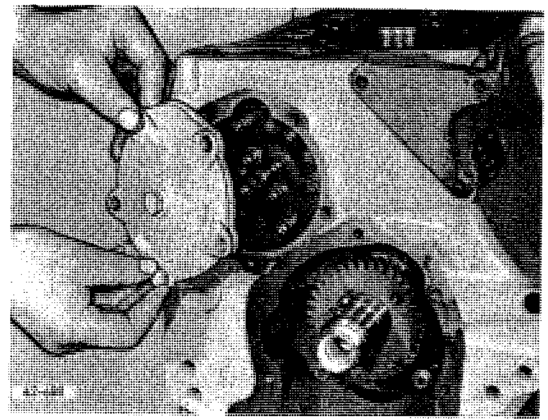
9-86

39. Measure set-back of contact surface at counter bolt relative to sealing surface at crankcase.

Note:

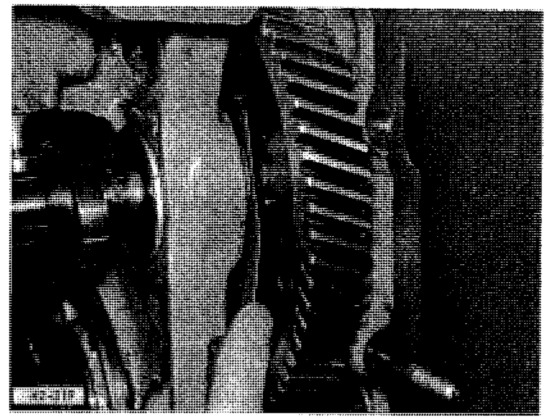
In order to obtain the necessary end float, drive counter bolt inwards accordingly.
Fig. 9-86

40. Mount camshaft cover c/w new gasket.
Fig. 9-87

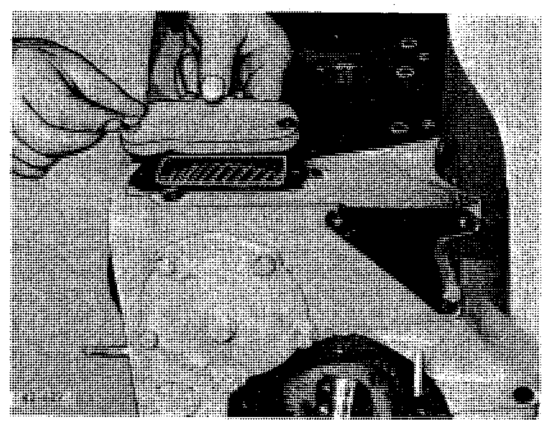

9-87

41. Check camshaft end float with feeler gauge.
Fig. 9-88

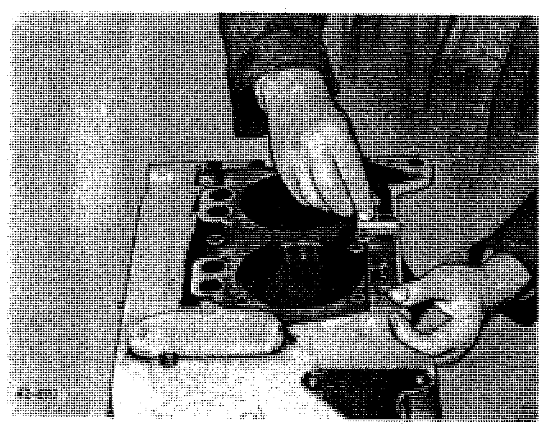
711

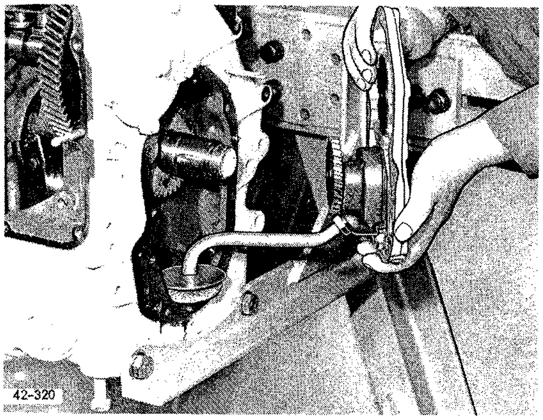

9-88

42. Mount upper camshaft cover c/w new gasket.
Fig. 9-89


9-89

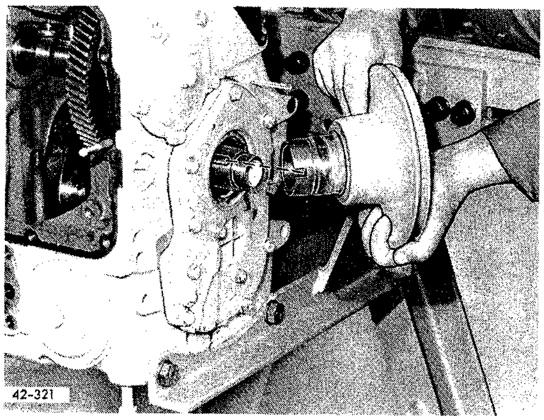
43. Place on bottom plate. Guide bolt through threaded sleeve, and fasten.
Fig. 9-90


9-90



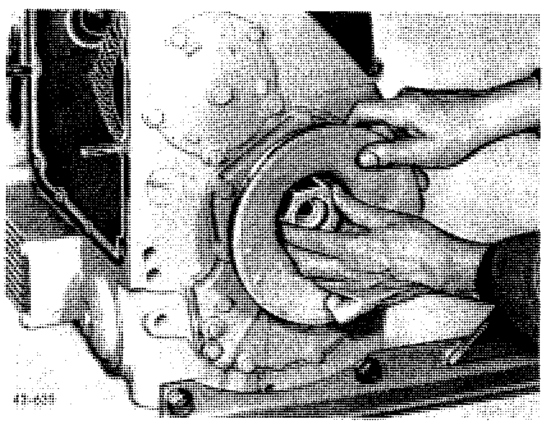
9-91

44. Mount front cover c/w new gasket and oil pump.
Fig. 9-91



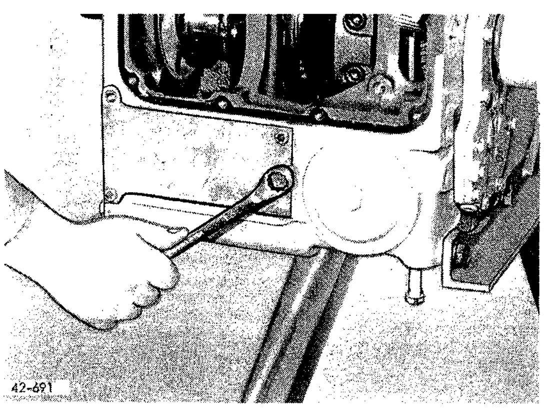
9-92

45. Oil shaft seal. Push on V-belt pulley over key.
Fig. 9-92



9-93

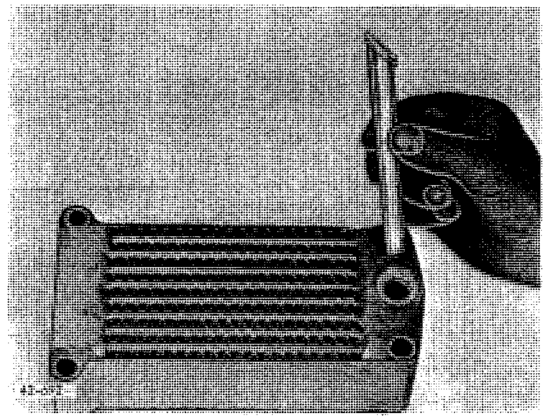
46. Screw on nut by hand.
Fig. 9-93



9-94

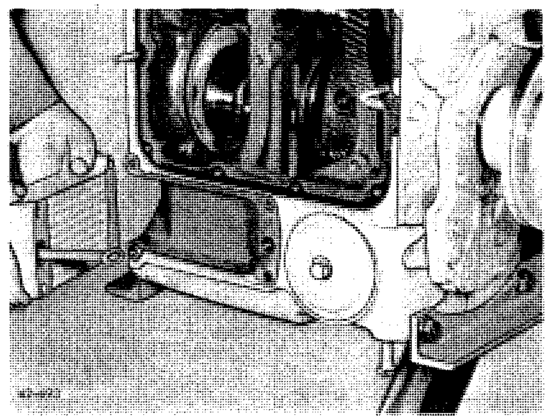
On engines without oil cooler:
Mount cover plate. Screw in plug c/w sealing ring.
Fig. 9-94

On engines with oil cooler:
Insert O-seal (arrow) with grease. Position oil pipe in oil cooler.
Fig. 9-95



9-95

47. Mount oil cooler.
Fig. 9-96

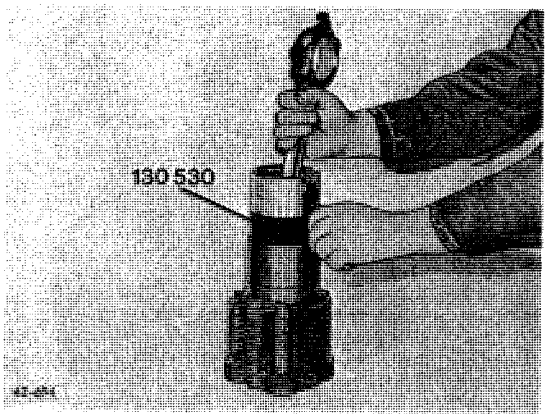


9-96

REASSEMBLING ENGINE
- Cylinder Unit -

Special tools required:

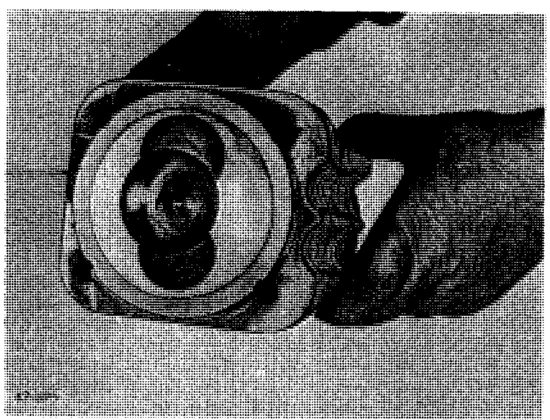
Socket wrench for
cylinder head bolts .. No. 120040
Spring compressor .... No. 125310
Piston ring clamp .... No. 130530
Pipe-head wrench for
big-end bolts .... No. 131540



9-97

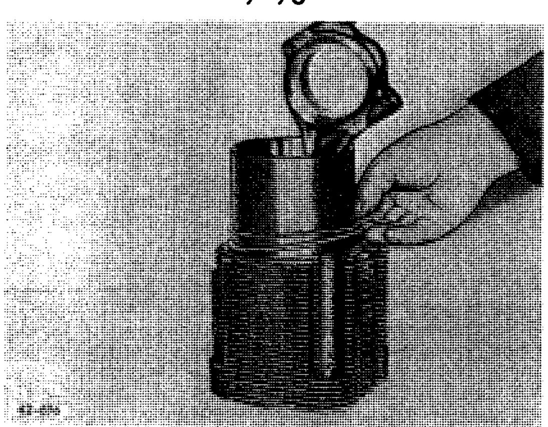
Piston and connecting rod are preassembled.

1. Oil cylinder and compress piston rings with clamp.
Fig. 9-97



9-98

2. Introduce piston into cylinder so that the arrow for "air discharge for side" points towards the recesses in cylinder for the pushrod cover tubes.
Fig. 9-98



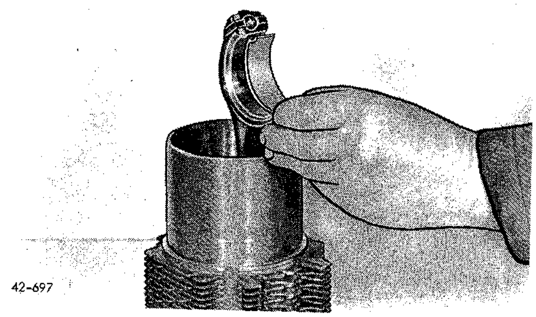
3. Affix shims in place with a little grease.

Note:

To permit correction without having to remove cylinder following piston crown clearance measurement, fit preferably three shims.
Fig. 9-99

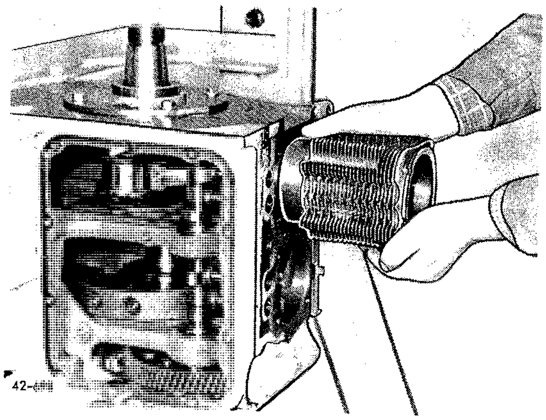
9-99

4. Fit bearing shells in connecting rod and matching bearing cap.
Fig. 9-100



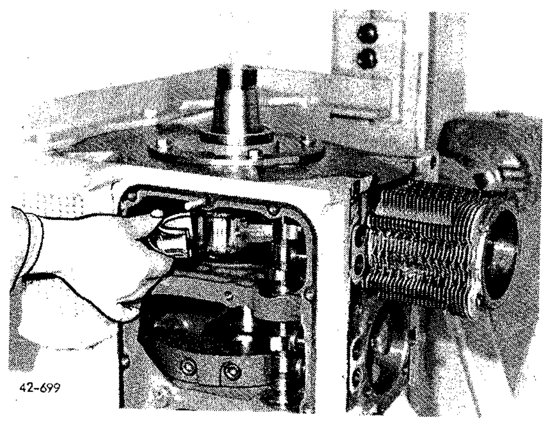
9-100

5. Insert cylinder c/w piston and connecting rod so that the arrow on piston crown points towards the tappet bores in crankcase.
Fig. 9-101



9-101

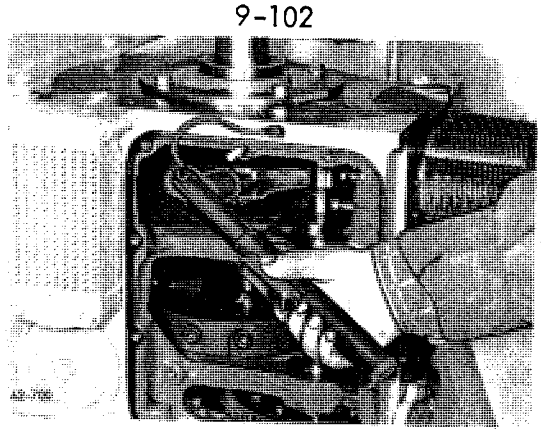
6. Oil big-end bearing. Fit bearing cap.
Fig. 9-102



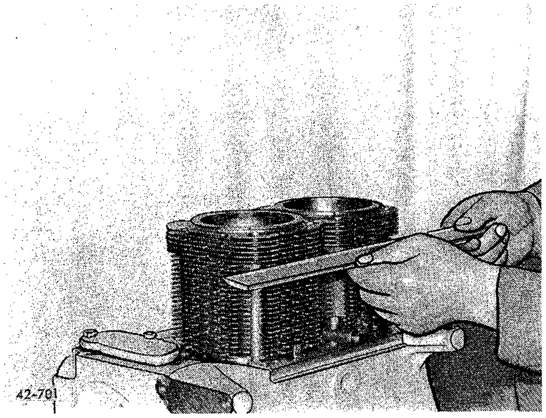
9-102

7. Insert new big-end bolts and tighten as specified.
Fig. 9-103

903



9-103

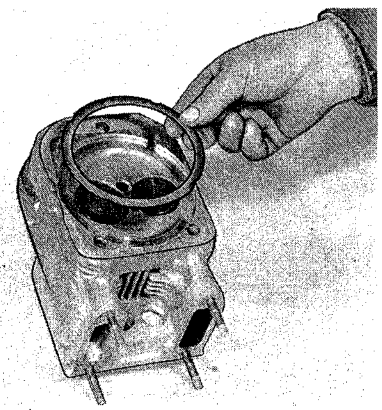


9-104

8. Align cylinders.
Fig. 9-104

Note:

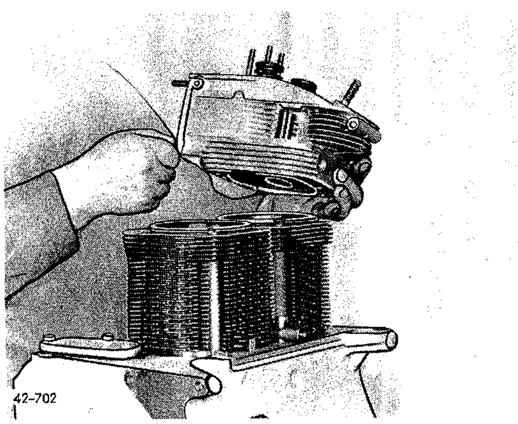
Check/adjust piston crown clearance. See Chapter 2.



42-83

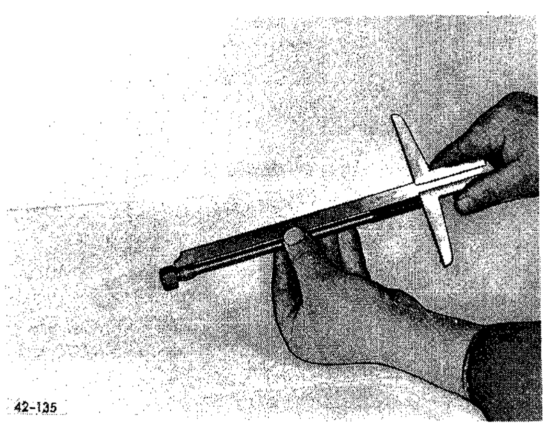
9-105

9. Affix intermediate rings with a little grease.
Fig. 9-105



9-106

10. Place on cylinder heads.
Fig. 9-106



9-107

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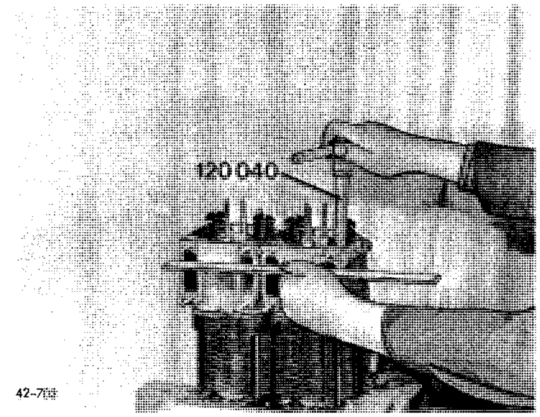
11. Measure length of cylinder head bolts; renew bolts if stretched.
Fig. 9-107

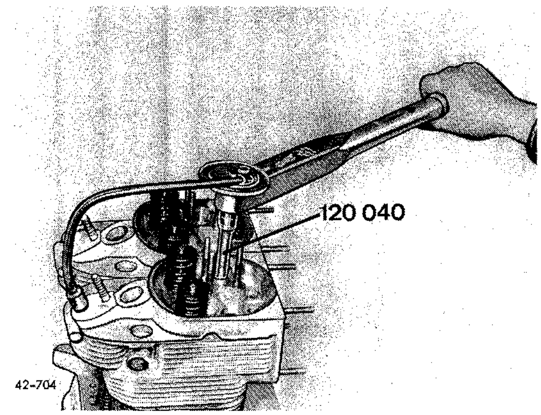
12. Insert cylinder head bolts c/w washers, with threads lightly oiled. Align cylinder heads.
Fig. 9-108



9-108

13.Tighten cylinder head bolts as specified.
Fig. 9-109

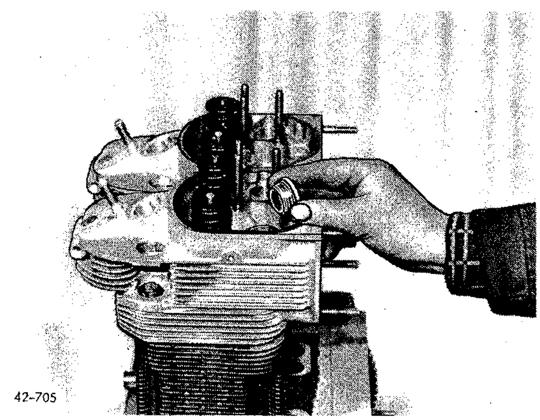
902



9-109

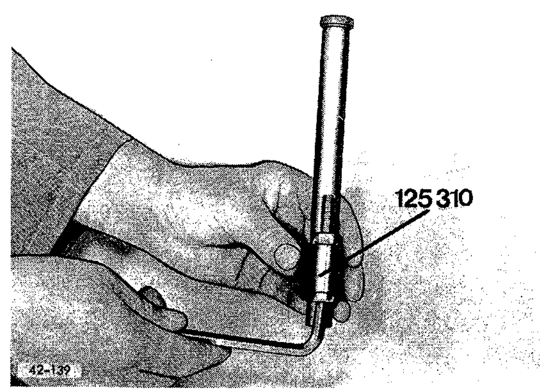
14. Insert plugs c/w sealing rings and tighten as specified.
Fig. 9-110

921

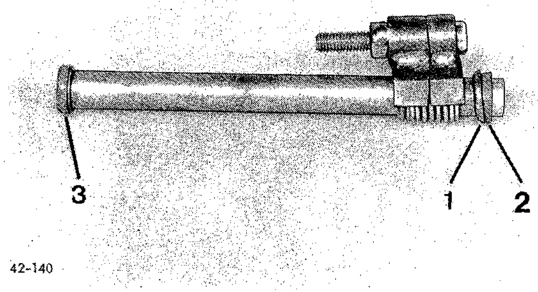


9-110

15. Fit spring on pushrod cover tube and compress with tool.
Fig. 9-111



9-111

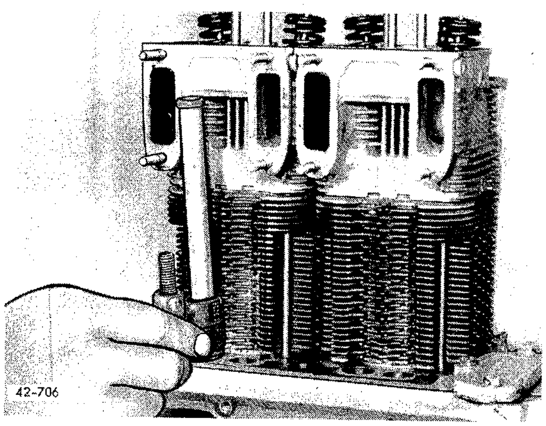


9-112

16. Preassemble pushrod cover tube with new profile seals.

Assembly sequence:

1. Profile washer
2. Lower profile seal
3. Upper profile seal
Fig. 9-112

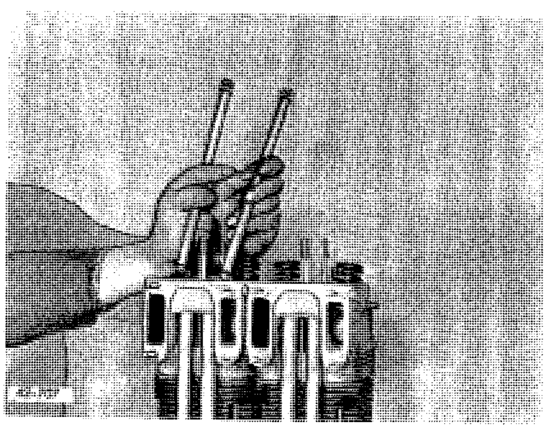


9-113

17. Introduce pushrod cover tube first into the crankcase and then into the cylinder head. Withdraw spring compressor.

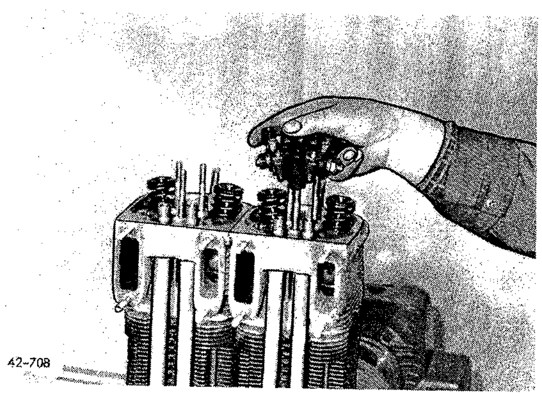
Note:

For installing the pushrod cover tubes in case of air-to-air heating system, see Chapter 3.
Fig. 9-113



9-114

18. Insert pushrods.
Fig. 9-114



19. Fit rocker arm brackets. Tighten nuts as specified.
Fig. 9-114

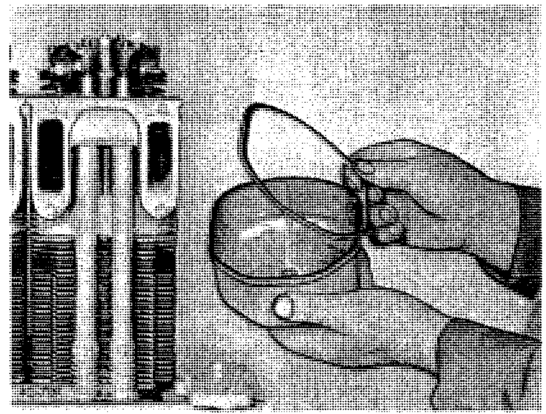
916

Note:

Set valve clearance, see Chapter 2.
Fig. 9-115

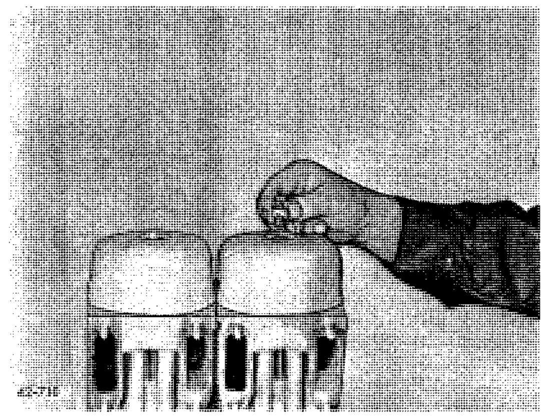
9-115

20. Affix gasket with sealing compound, the graphited surface facing towards cylinder head.
Fig. 9-116



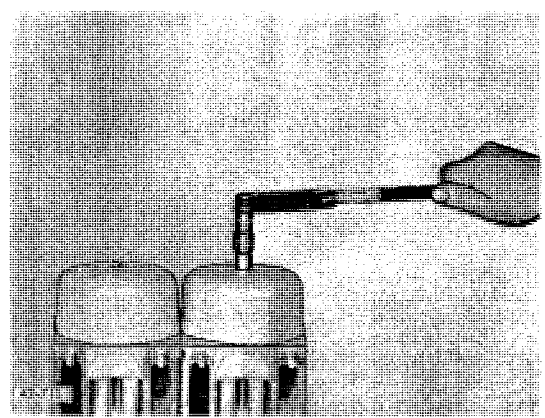
9-116

21. Fit rocker chamber covers and insert bolts c/w joint washers.
Fig. 9-117



9-117

22. Tighten bolts as specified.
Fig. 9-118

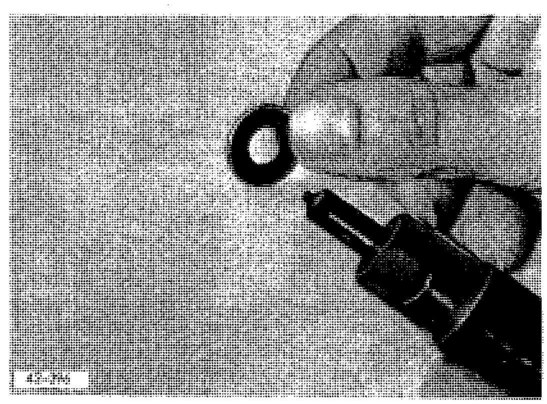


9-118

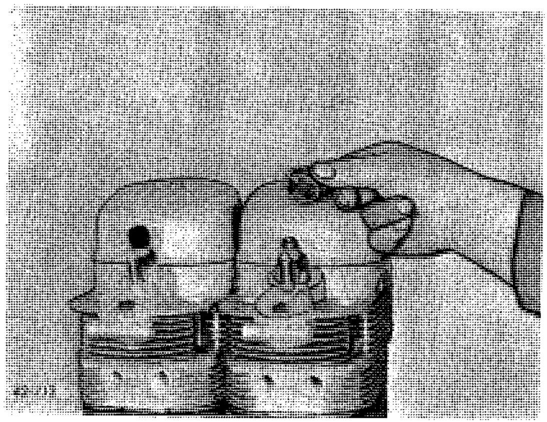
23. Affix special sealing ring with a little grease on graphited side onto injector.

Note:

Installation of injector in case of 2-stage combustion: See Chapter 7.
Fig. 9-119

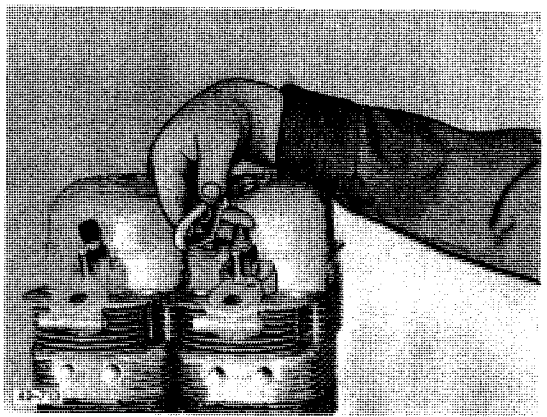


9-119



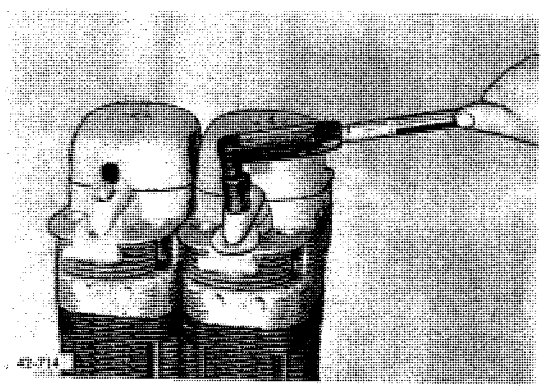
9-120

24. Install injector. Insert guide piece.
Fig. 9-120



9-121

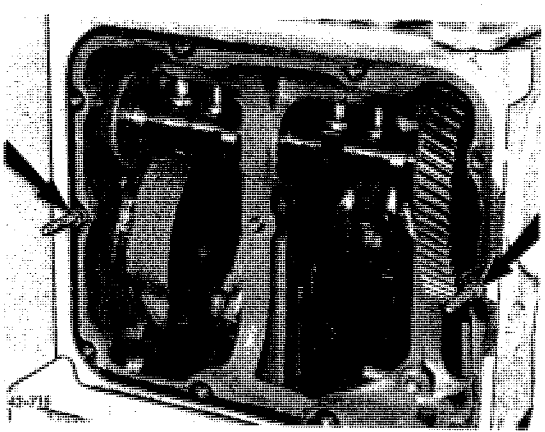
25. Place on clamping bridge.
Fig. 9-121



9-122

910

26. Screw on hex. nut for fastening injector and tighten as specified.
Fig. 9-122

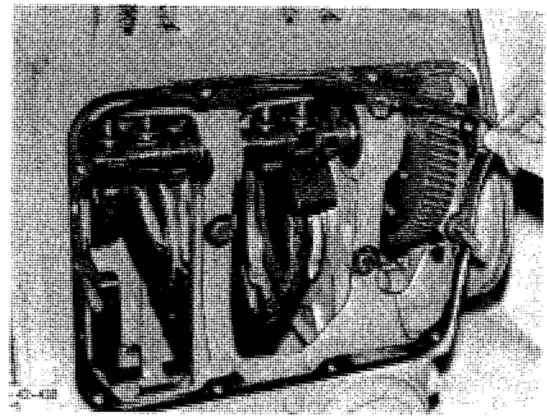


9-123

MOUNTING DEUTZ INJECTION PUMP
- F2L 912 -

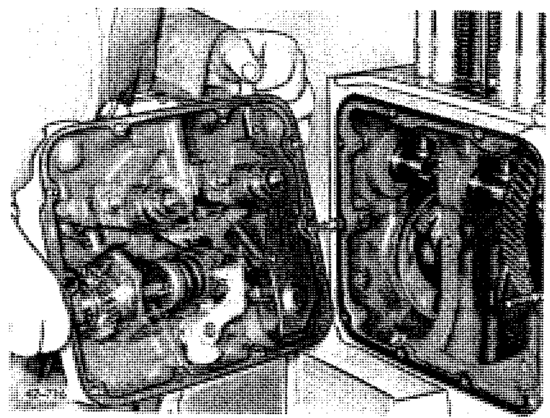
1.Before mounting injection pump, check presence of dowel sleeves.
Fig. 9-123

2. Affix gasket with grease.
Fig. 9-124



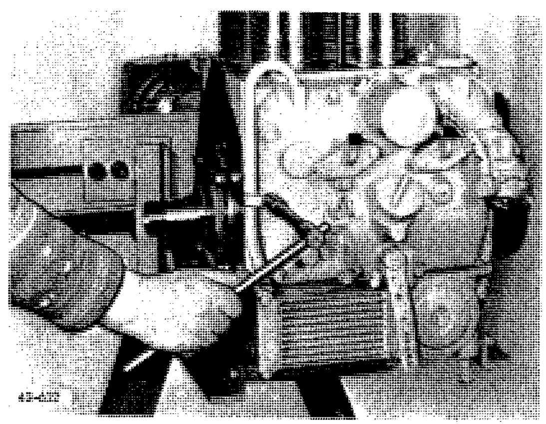
9-124

3. Turn crankshaft until cams for injection pump elements point towards crankcase. Mount injection pump, making sure that the teeth engage.
Fig. 9-125

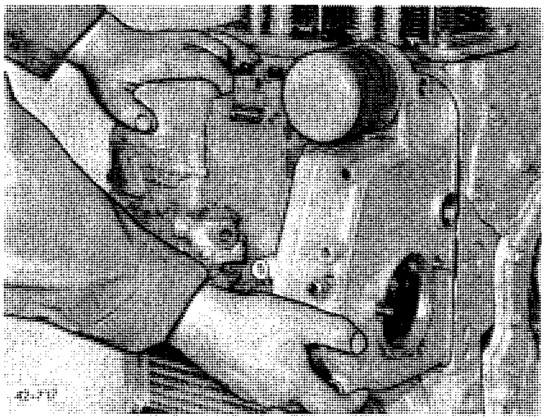


9-125

4. Tighten injection pump fastening bolts.
Fig. 9-126



9-126



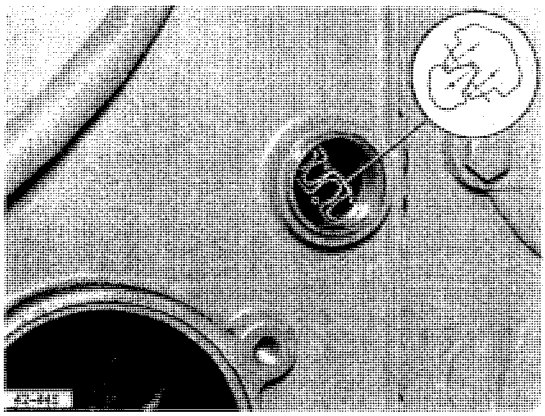
9-127

MOUNTING BOSCH INJECTION PUMP

Note:

Engine camshaft for Bosch pump is installed, also marked camshaft gear.

1. Mount injection pump carrier with gasket and Bosch pump.
Fig. 9-127

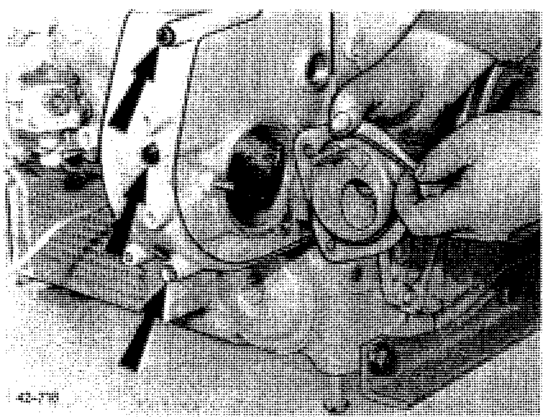


9-128

2. Turn crankshaft until punchmarks on engine camshaft gear and injection pump gear are visible.

Note:

Adjusting beginning of delivery: see Chapter 2.
Fig. 9-128



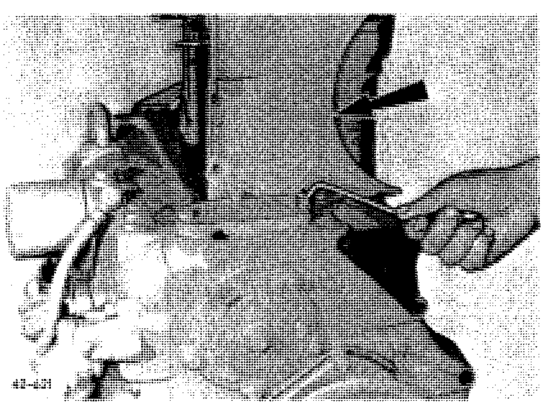
9-129

3. Tighten bolts for injection pump carrier and mount cover at front c/w O-seal.
Fig. 9-129

FINAL ASSEMBLY OF ENGINE

Special tools required:

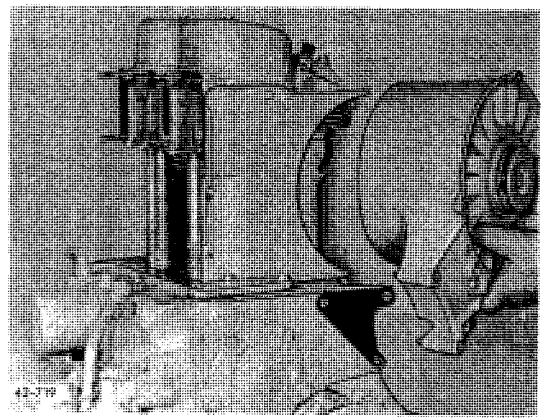
Hammering wrench ..... No. 141410
Mandrel .... No. 143000
Retainer .... No. 143400



9-130

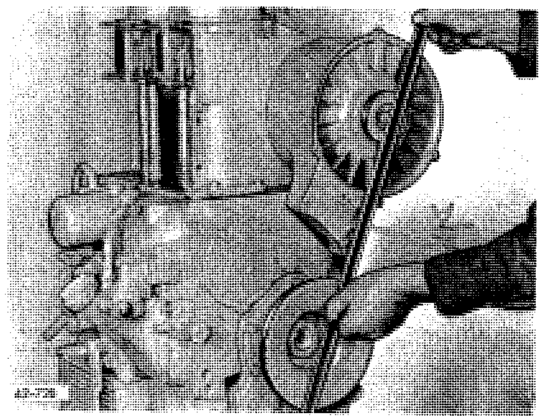
1. Mount front stay plate.
Fig. 9-130

2. Mount cooling blower.
Fig. 9-131



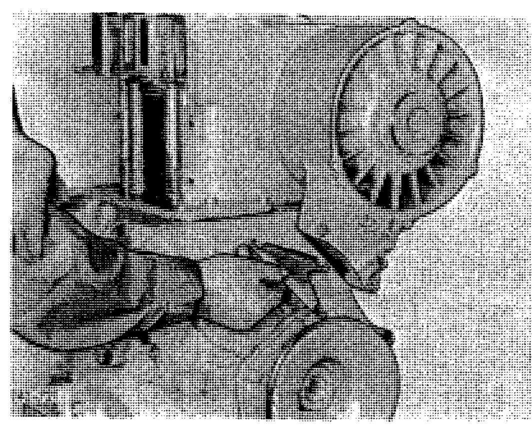
9-131

3. Check alignment of V-belt pulleys.
Fig. 9-132



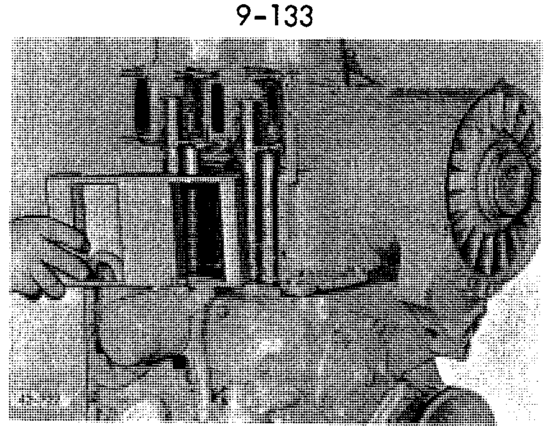
9-132

4. Correct any misalignment with shim plates.
Fig. 9-133

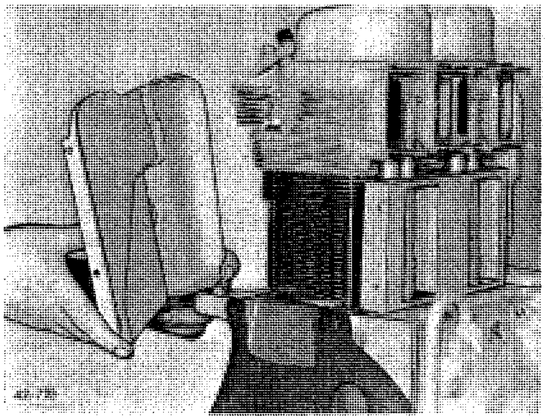


9-133

5. Mount discharge air baffle.
Fig. 9-134

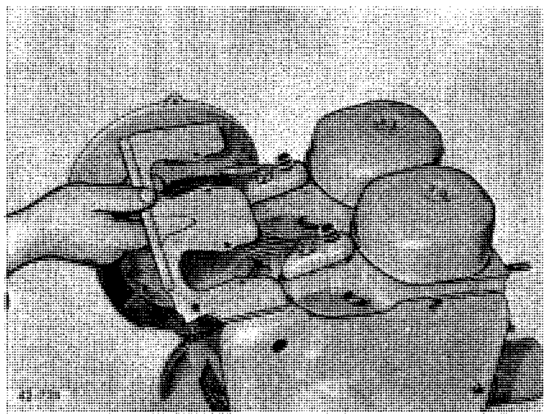


9-134



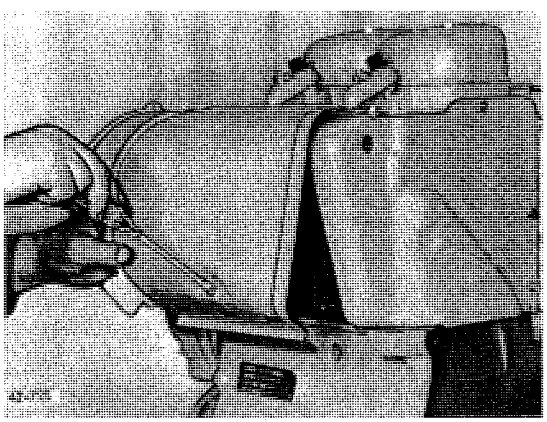
9-135

6. Mount stay plate at flywheel end.
Fig. 9-135



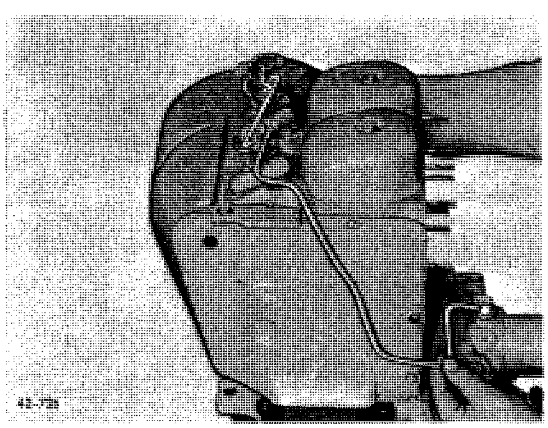
9-136

7. Mount upper cover plate.
Fig. 9-136



9-137

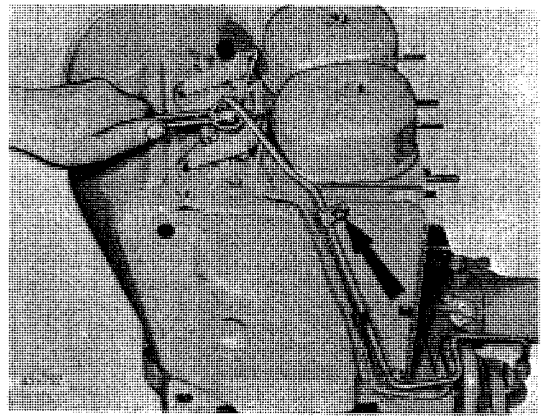
8. Hook in air cowling at upper cover plate and fasten at bottom.
Fig. 9-137



9-138

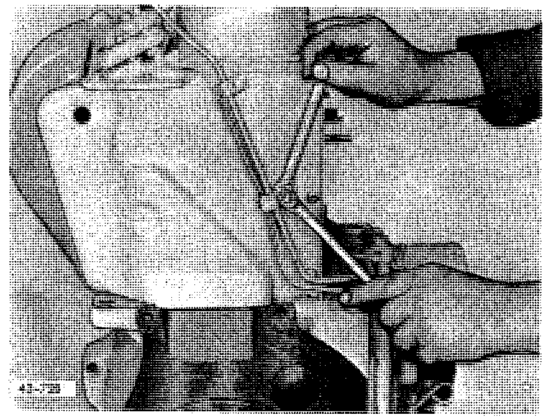
9. Attach backleakage line c/w new sealing rings.
Fig. 9-138

10. Attach injection line for cylinder 1 and fasten with clip on stay plate at flywheel end.
Fig. 9-139



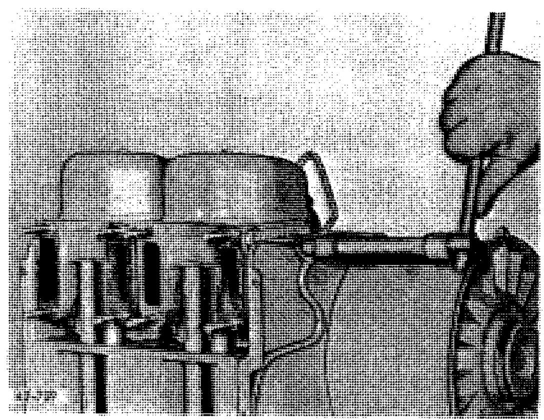
9-139

11. Fasten backleakage line additionally with clip at injection line.
Fig. 9-140



9-140

12. Fasten injection line for cylinder 2 with clip on front stay plate.
Fig. 9-141

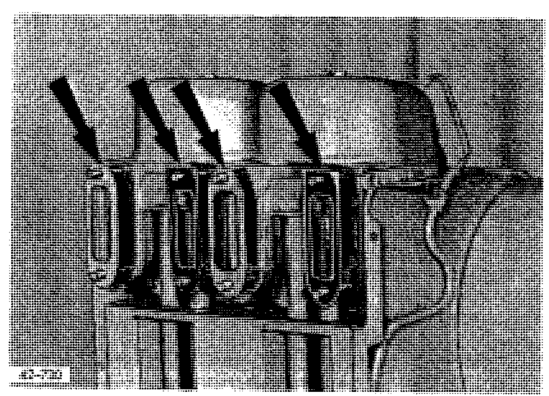


9-141

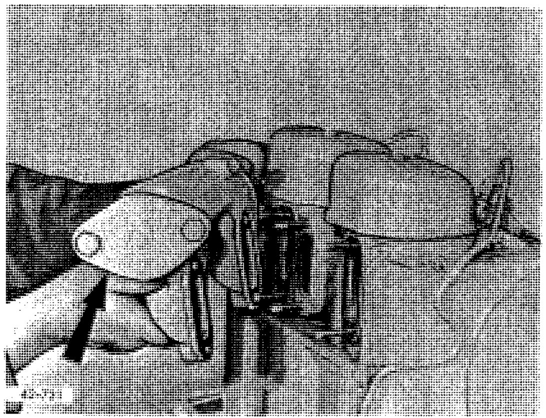
13. Mount gasket for intake and exhaust manifolds, flattened ends at top.

Note:

Intake duct is at right.
Fig. 9-142

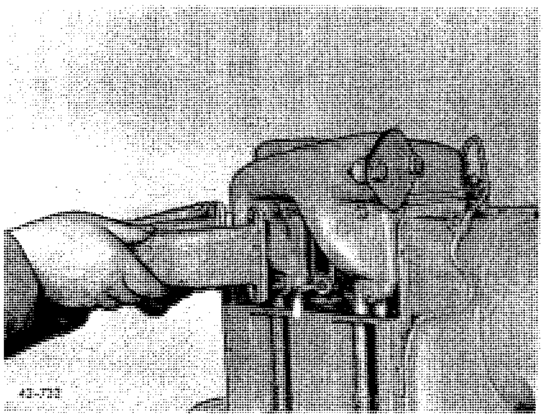


9-142



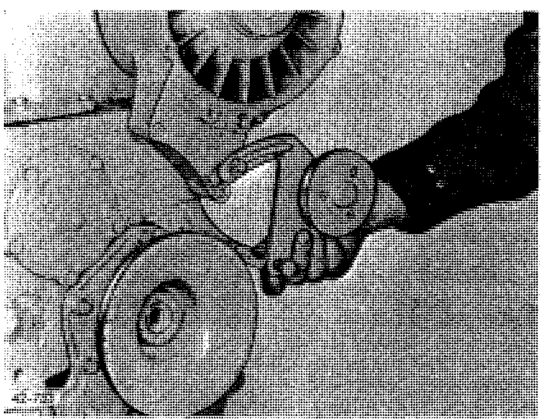
9-143

14. Mount intake manifold. Close opening.
Fig. 9-143



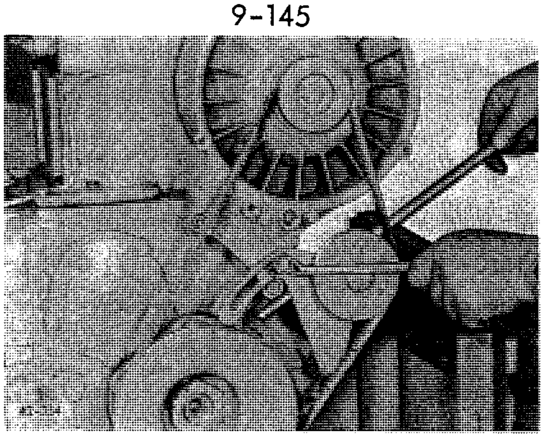
9-144

15. Mount exhaust manifold. Close opening.
Fig. 9-144



9-145

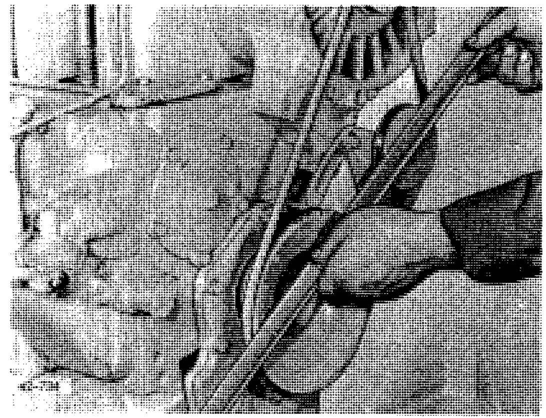
16. Mount V-belt tensioning pulley.
Fig. 9-145



9-146

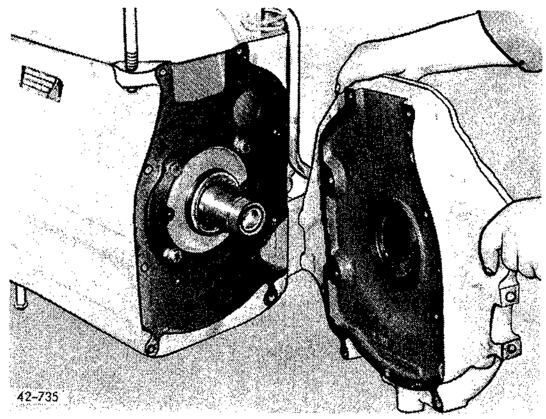
17. Place on V-belt, tension, and tighten bolts.
Fig. 9-146

18. Check alignment of V-belt pulleys.
Fig. 9-147



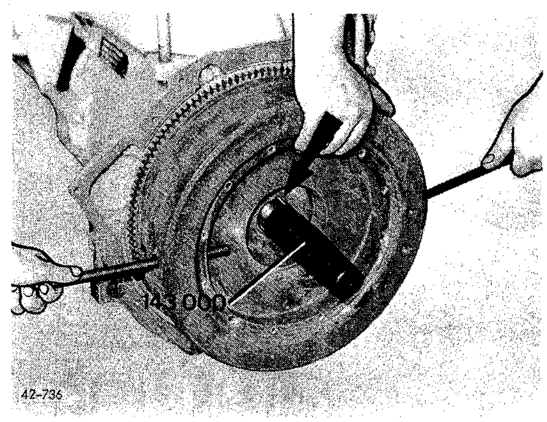
9-147

19. Remove engine from assembly stand. Mount adapter housing.
Fig. 9-148



9-148

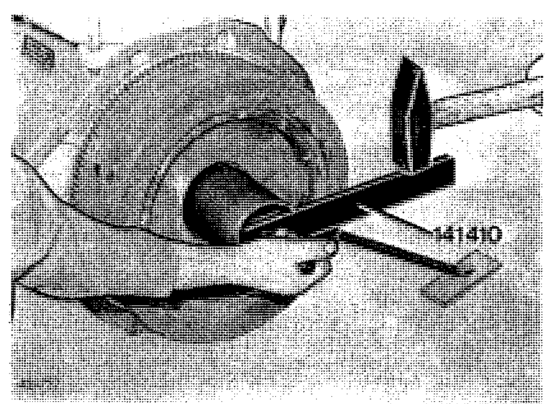
20. Insert key for flywheel. Cones of crankshaft and flywheel must be free from oil. Insert assembly mandrel into crankshaft and push on flywheel, making sure that keyway of flywheel engages with key.
Fig. 9-149



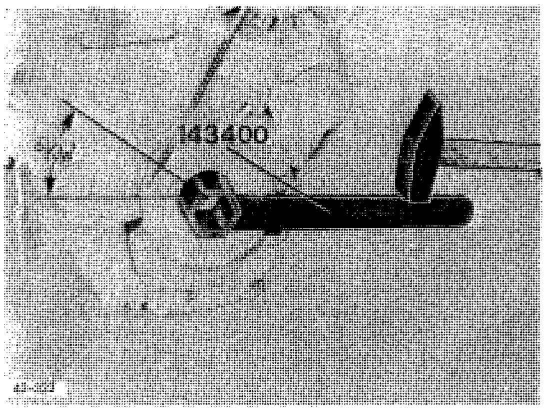
9-149

21. Lock flywheel, tighten nut as specified.
Fig. 9-150

907



9-150



9-151

22. Lock flywheel and finally tighten as specified the already pre-loaded nut of the V-belt pulley.
Fig. 9-151

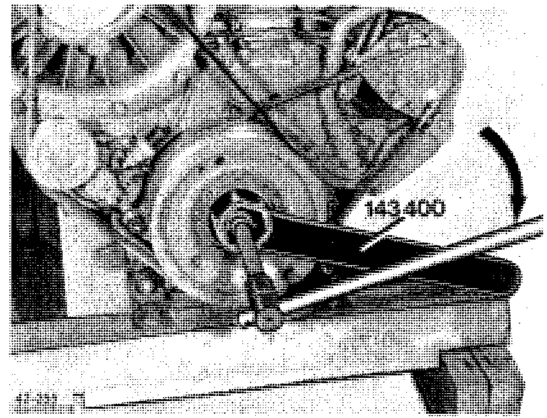
DISMANTLING ENGINE
- as from 3-cyl. engines -

Special tools required:

Extractor .... No. 110030
Screw fitting .... No. 110050
Device .... No. 110340
Socket wrench .... No. 120040
Retainer .... No. 143400
Extractor .... No. 150800

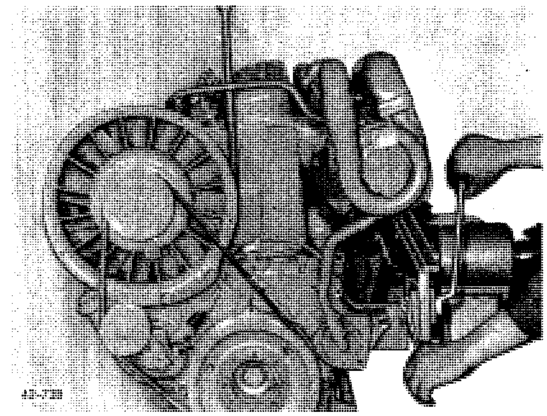
Note:

Before fastening engine to assembly stand, loosen bolt (lef-hand thread) at V-belt pulley.
Fig. 9-152



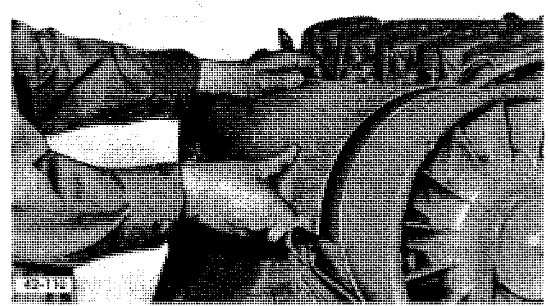
9-152

1. Fasten engine to assembly stand No. 6067.
Fig. 9-153



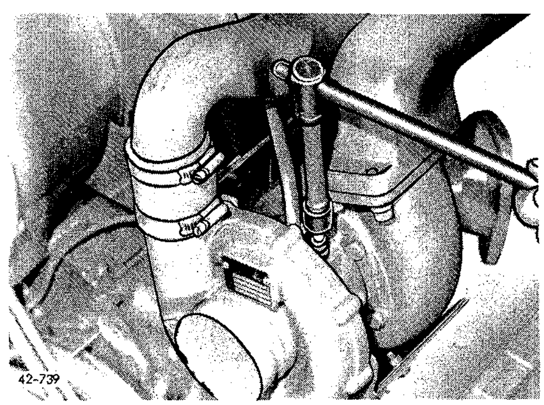
9-153

2.Remove air cowling.
Fig. 9-154

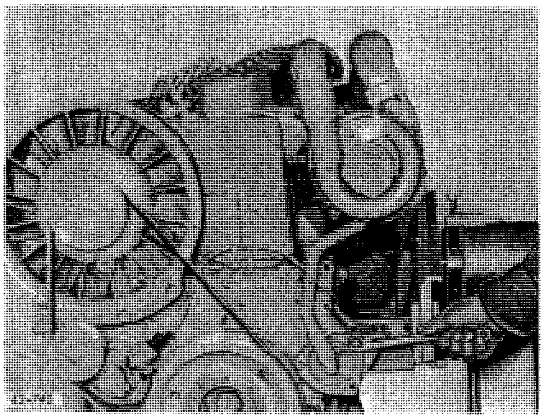


9-154

3. Remove lube oil pipe for turbocharger.
Fig. 9-155

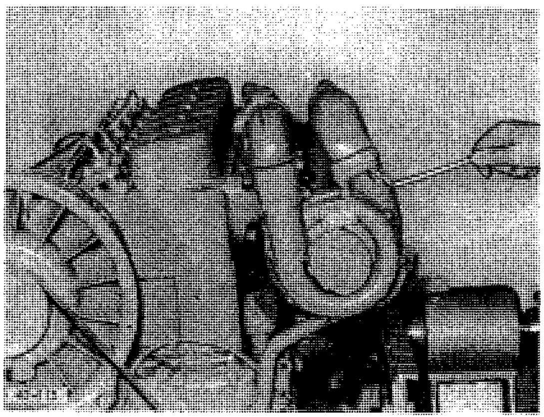


9-155



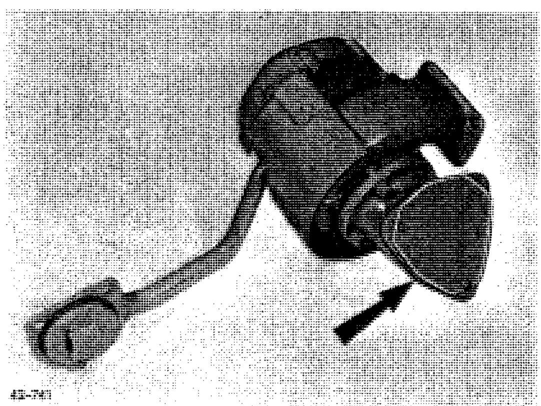
9-156

4. Remove cover together with oil return pipe. Undo hose clip at air intake manifold.
Fig. 9-156



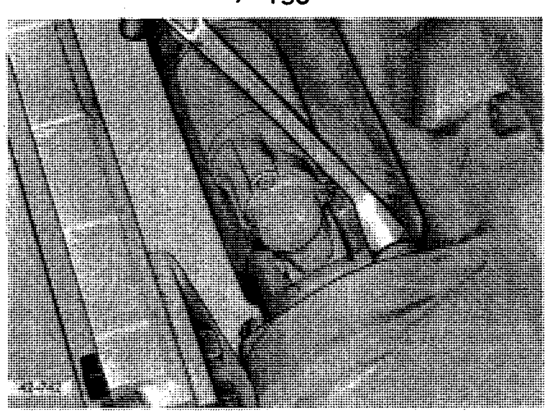
9-157

5. Screw out bolts at flange of turbocharger and take off turbocharger.
Fig. 9-157



9-158

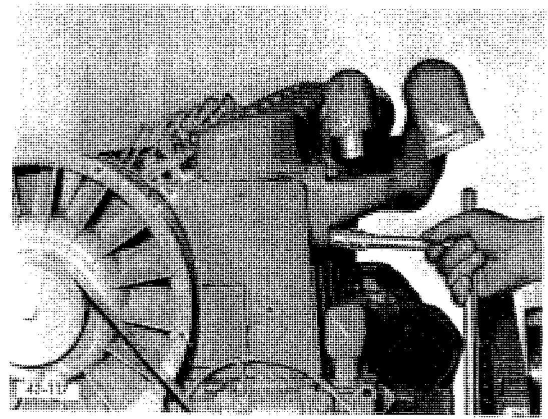
6. Close flange at bend of turbocharger.
Fig. 9-158



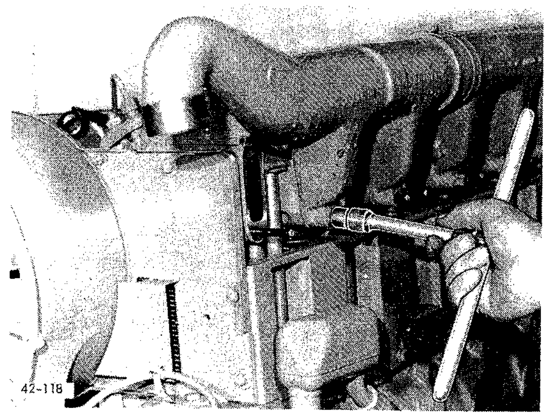
9-159

7. Remove starter motor.
Fig. 9-159

8. Remove exhaust manifold.
Fig. 9-160

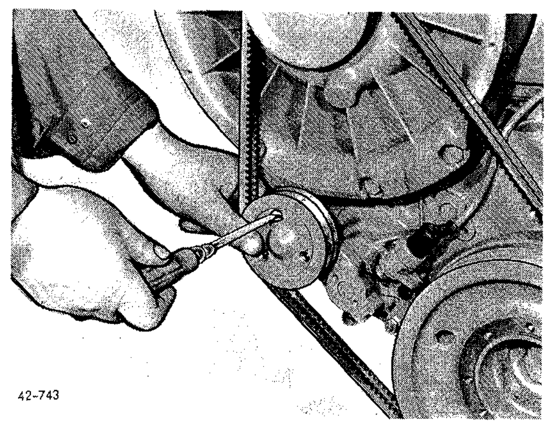

9-160

9. REmove air intake manifold.
Fig. 9-161



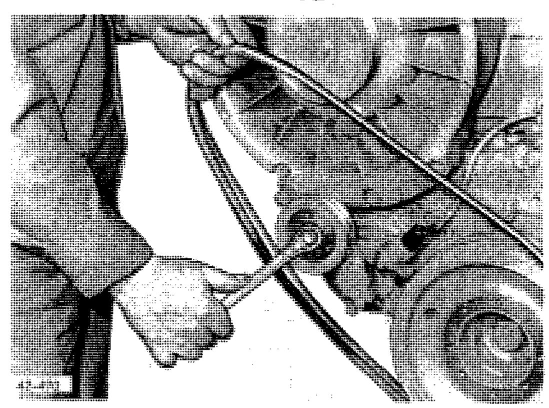
9-161

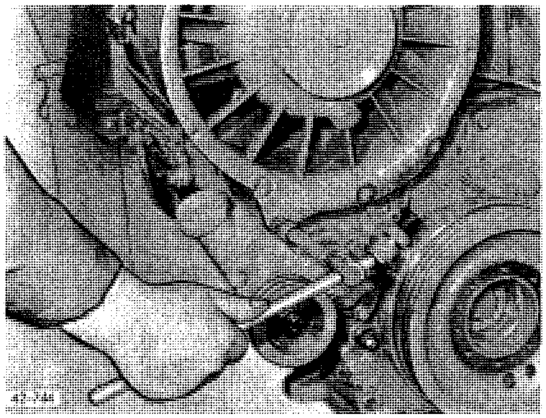
10. Screw off cover at tensioning pulley.
Fig. 9-162



9-162

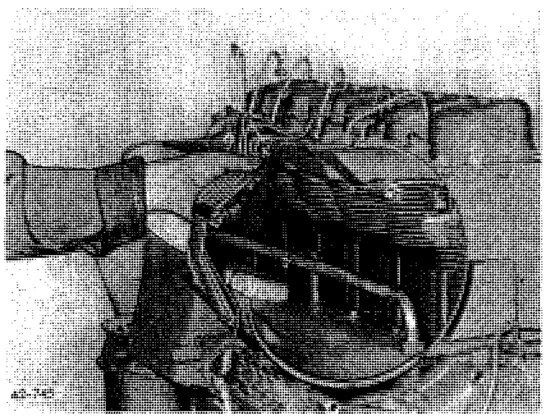
11. Press tensioning pulley upwards with ring spanner and take off V-belts.
Fig. 9-163


9-163



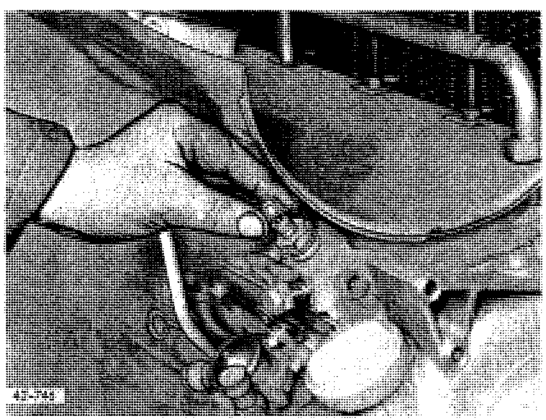
9-164

12. Remove cooling blower.
Fig. 9-164



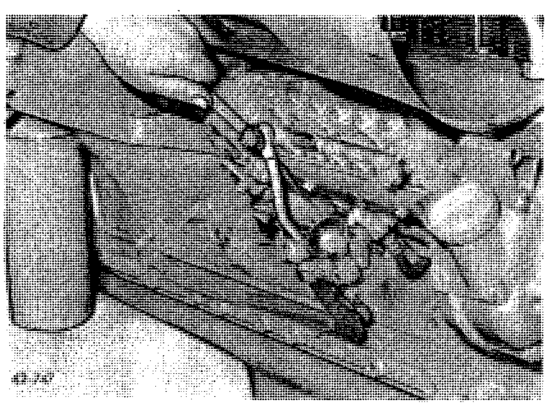
9-165

13. Detach injection lines and backleakage line.
Fig. 9-165



9-166

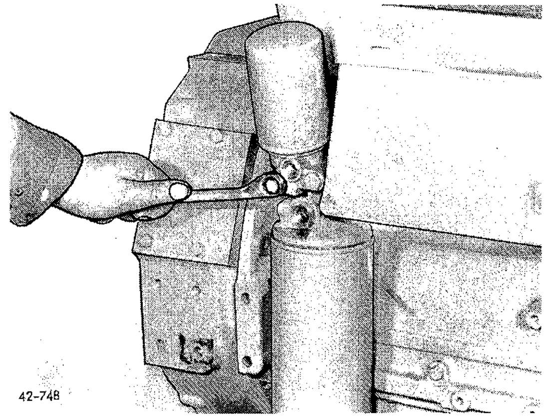
14. Close connection ports for injection lines and injectors with protective caps.
Fig. 9-166



9-167

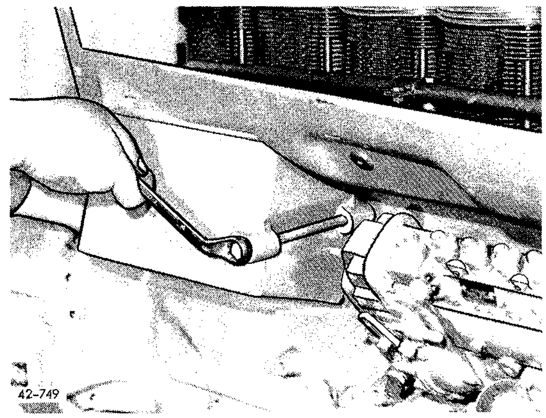
15. Detach fuel lines at injection pump, feed pump and fuel filter.
Fig. 9-167

16. Remove filter bracket with fuel and lube oil filtes.
Fig. 9-168



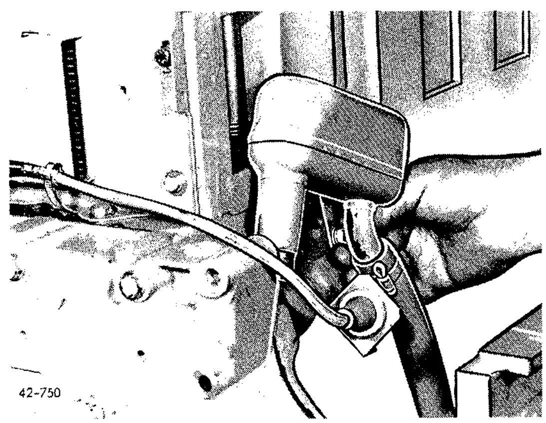
9-168

17. Screw out bolt for lube oil cooler and take off cooler.
Fig. 9-169



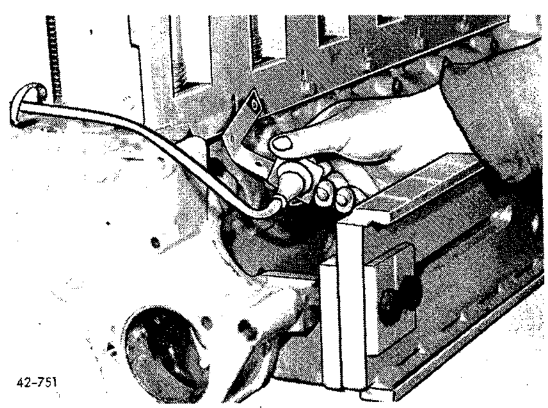
9-169

18. Remove breather.
Fig. 9-170

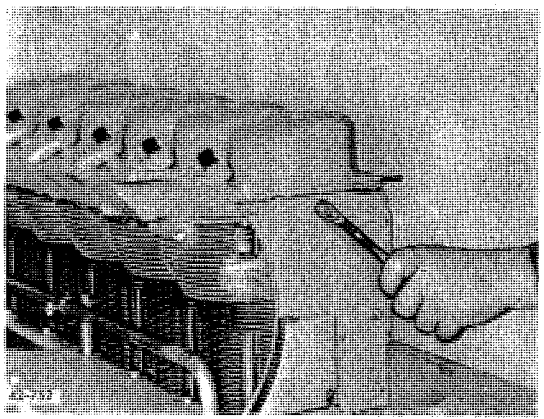


9-170

19. Remove retainer for warning switch cable. Screw off union nut. Withdraw coupling plug.
Fig. 9-171

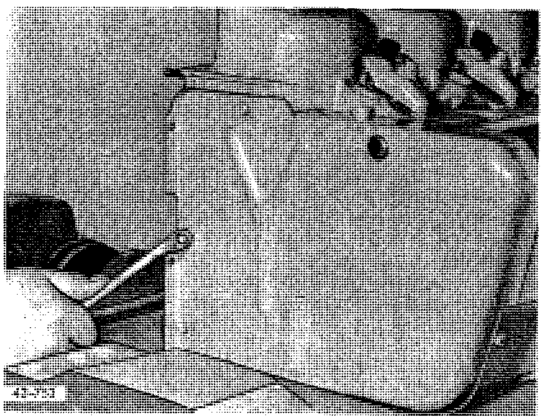


9-171



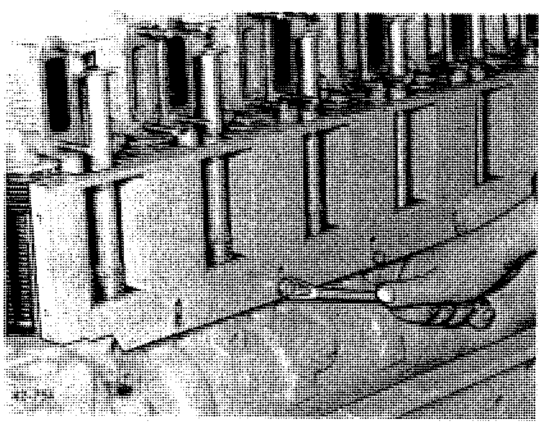
9-172

20. Remove front stay plate.
Fig. 9-172



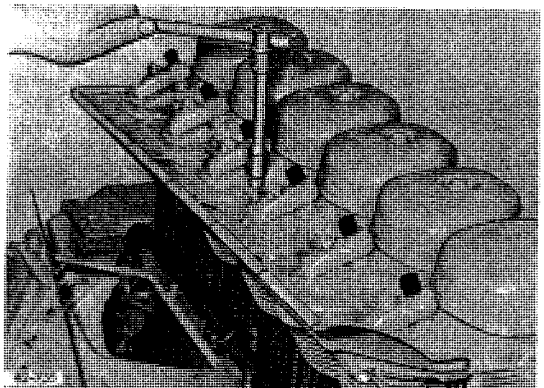
9-173

21. Remove rear stay plate.
Fig. 9-173



9-174

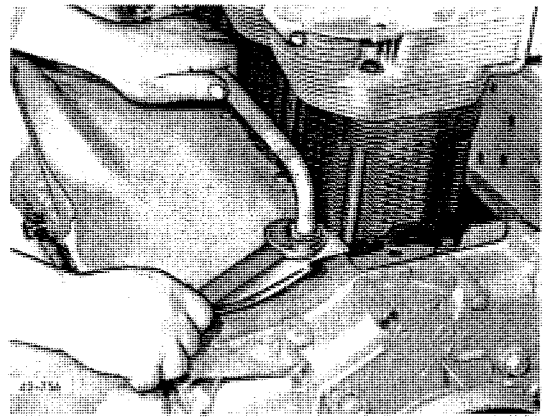
22. Remove cover plate discharge air side.
Fig. 9-174



9-175

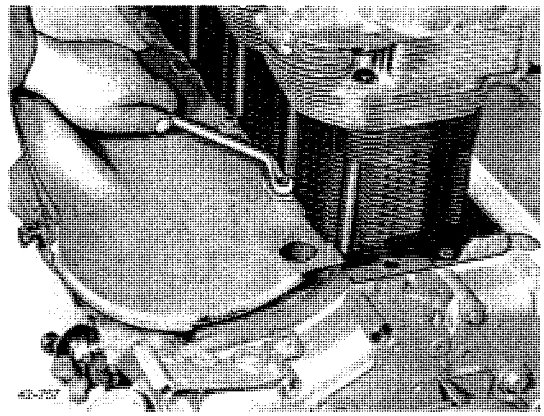
23. Remove upper cover plate.
Fig. 9-175

24. Remove oil pipe.
Fig. 9-176



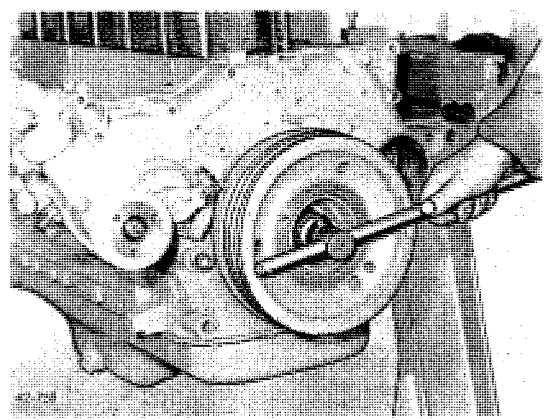
9-176

25. Remove air cowling bottom part.
Fig. 9-177



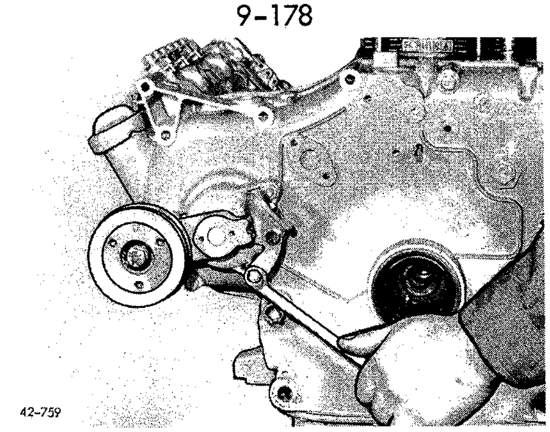
9-177

26. Screw out already loosened bolt of V-belt pulley and take off pulley.
Fig. 9-178

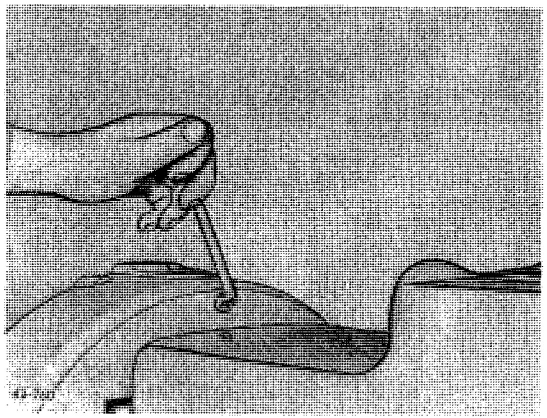


9-178

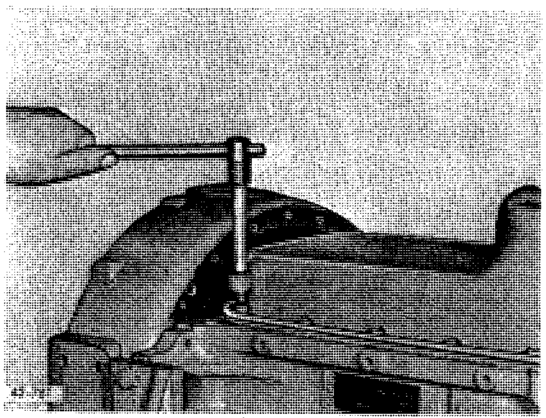
27. Remove V-belt tensioning pulley.
Fig. 9-179



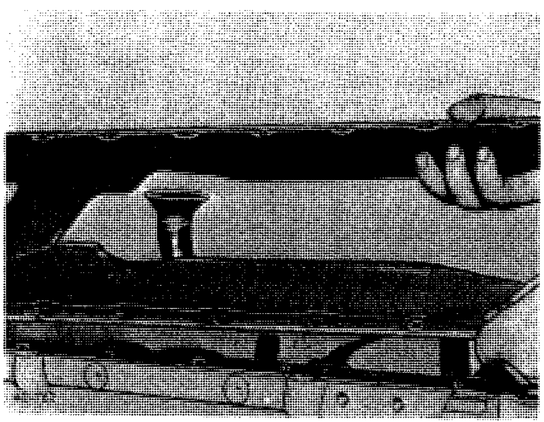
9-179


9-180

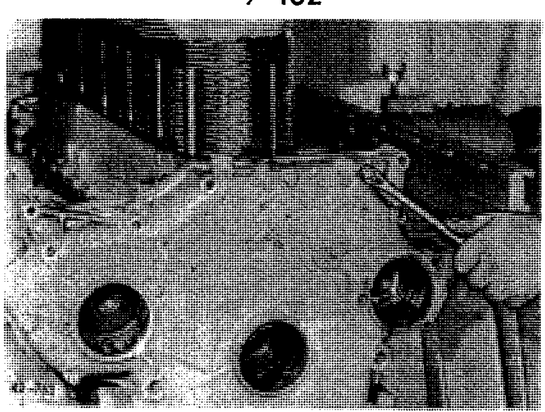
28. Remove cover plate at adapter housing.
Fig. 9-180


9-181

29. Screw out fastening bolts of oil pan. Take off oil pan.
Fig. 9-181

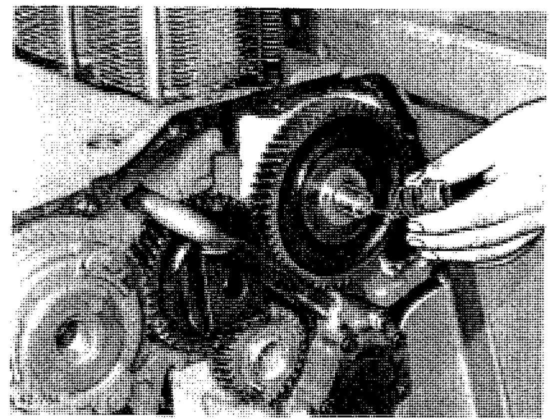

9-182

30. Take off intermediate plate.
Fig. 9-182


9-183

31. Remove front cover.
Fig. 9-183

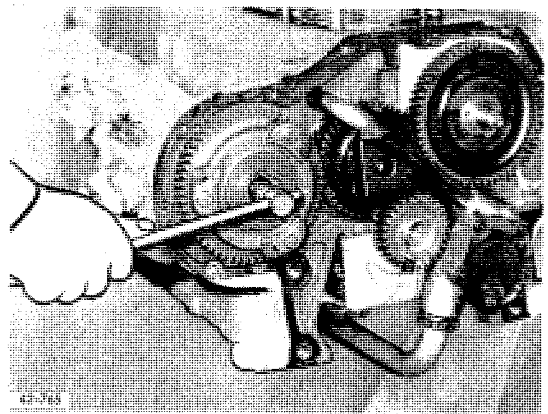
32. Remove thrust cap with spring from camshaft.
Fig. 9-184



9-184

33. Engines with advance/retard unit and Bosch "A" injection pump:

Screw off nut at injection pump drive from injection pump shaft.
Fig. 9-185

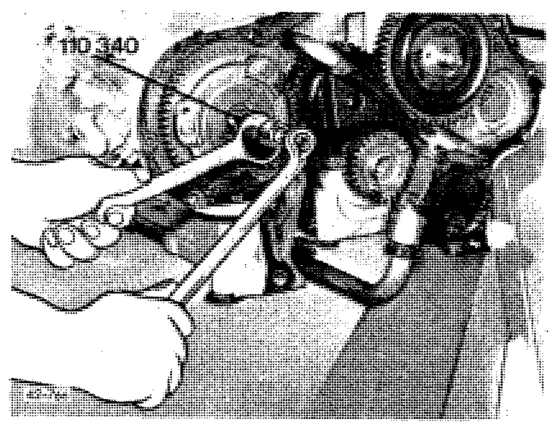


9-185

34. Press advance/retard unit off cone of camshaft.

Note:

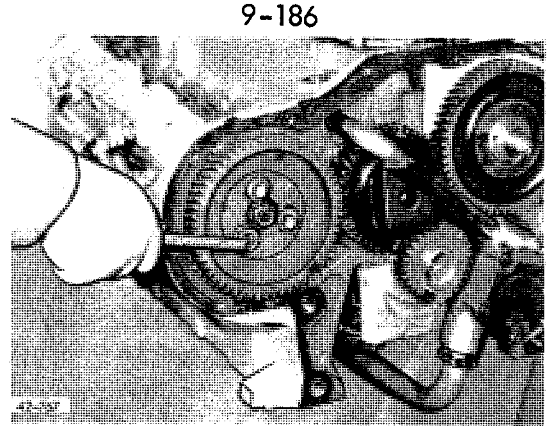
Engines with advance/retard unit and Bosch "MW" injection pump: See Chapter 7.
Fig. 9-186



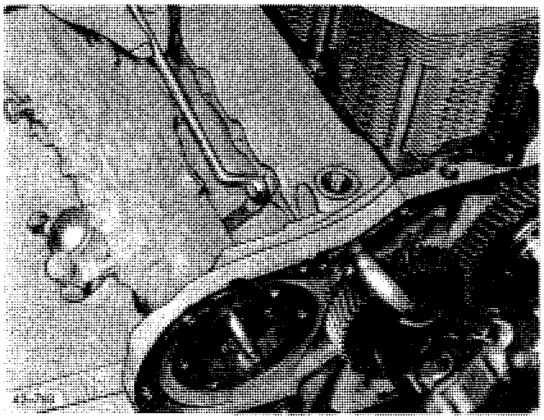
9-186

35. Engines without advance/retard unit:

Undo bolts at gear and take off gear.
Fig. 9-187

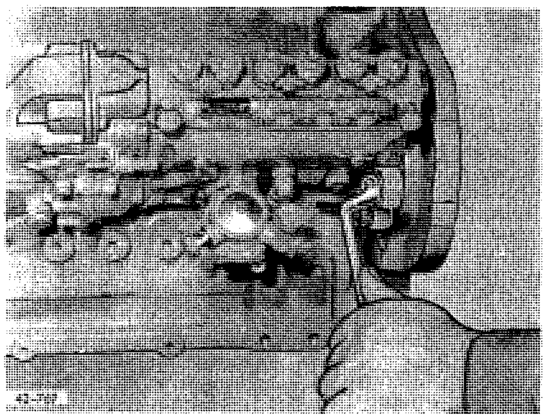


9-187



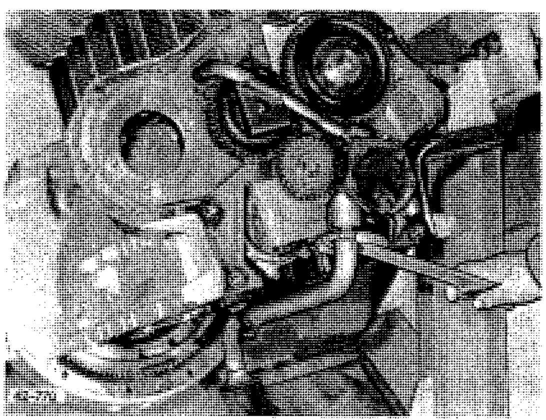
9-188

36. Remove lube oil line for injection pump.
Fig. 9-188



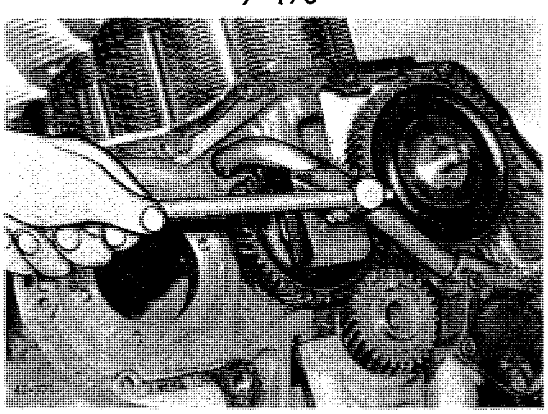
9-189

37. Screw off nuts at fastening flange of injection pump. Take off pump.
Fig. 9-189



9-190

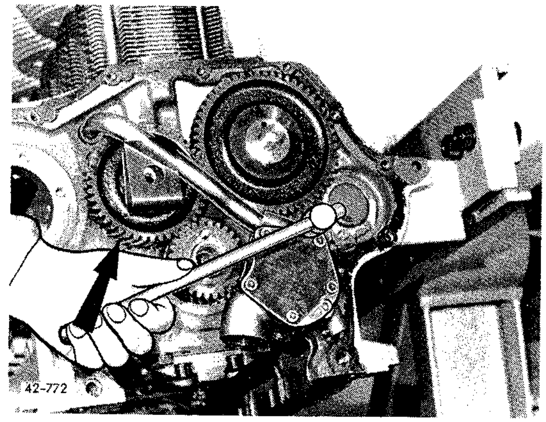
38. Undo fastening of oil suction pipe and union nut at oil pump.
Fig. 9-190



9-191

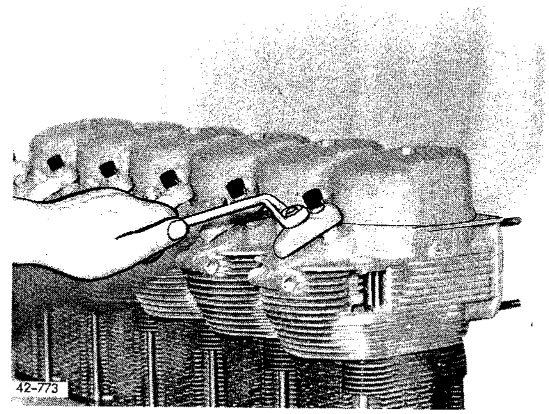
39. Remove bolt for idler gear.
Fig. 9-191

40. Remove oil pump. Take off idler gear.
Fig. 9-192



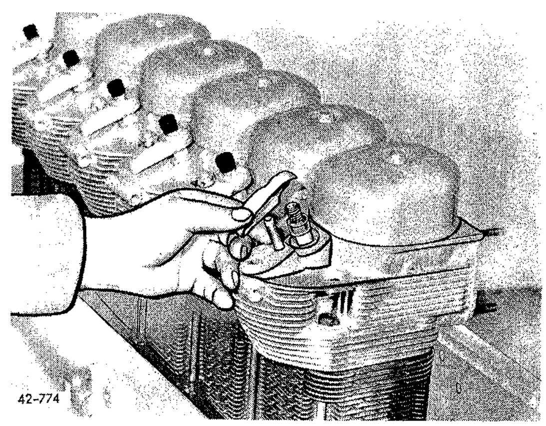
9-192

41. Screw off fastening nut for injector.
Fig. 9-193



9-193

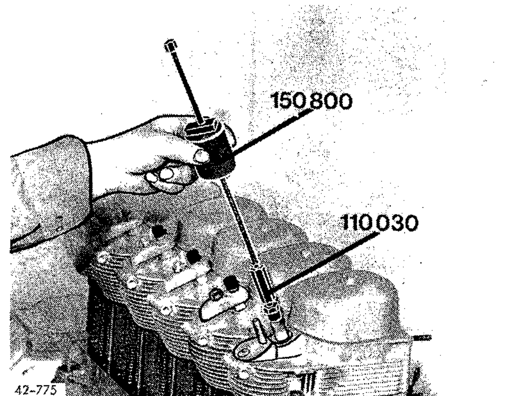
42. Remove clamping bridge.
Fig. 9-194



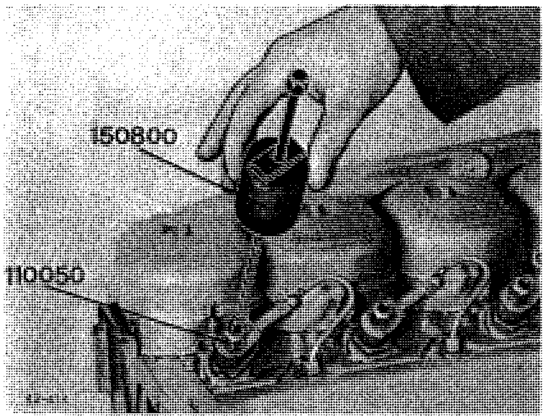
9-194

43. In case of direct injection:

Remove injector.
Fig. 9-195



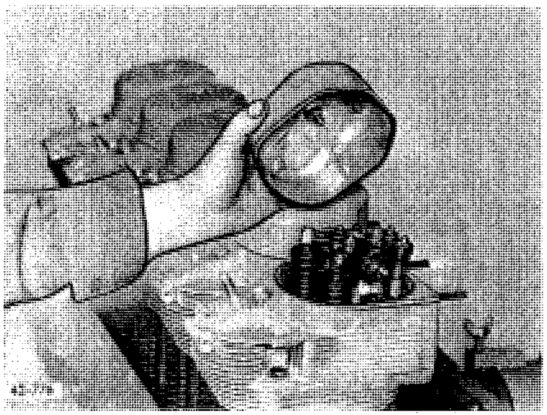
9-195



9-196

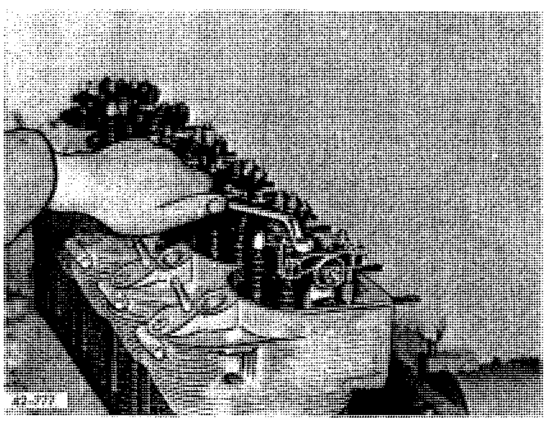
44. In case of two-stage combustion:

Remove injector.
Fig. 9-196



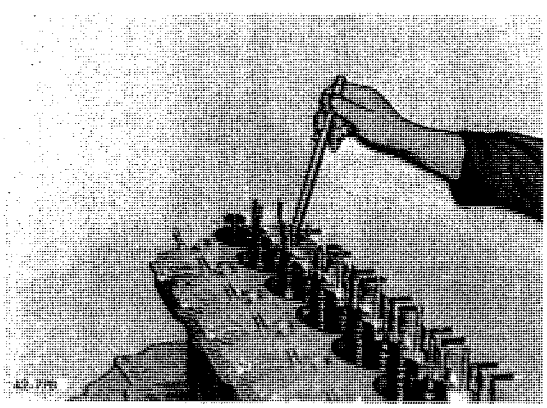
9-197

45. Remove rocker chamber covers.
Fig. 9-197



9-198

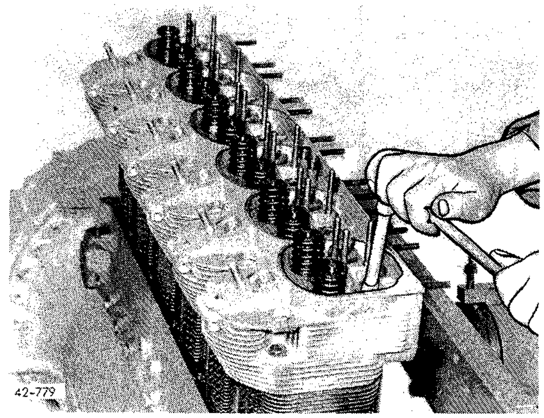
46. Remove rocker arm brackets.
Fig. 9-198



9-199

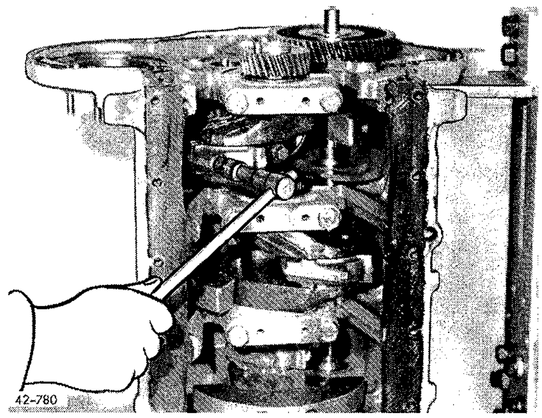
47. Take out pushrods.
Fig. 9-199

48. Screw out plugs.
Fig. 9-200



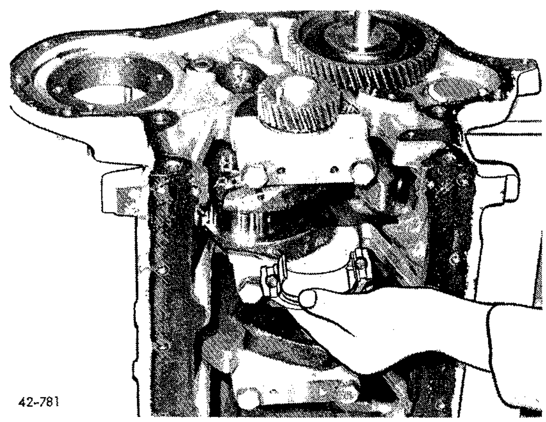
9-200

49. Screw out big-end bearing bolts.
Fig. 9-201



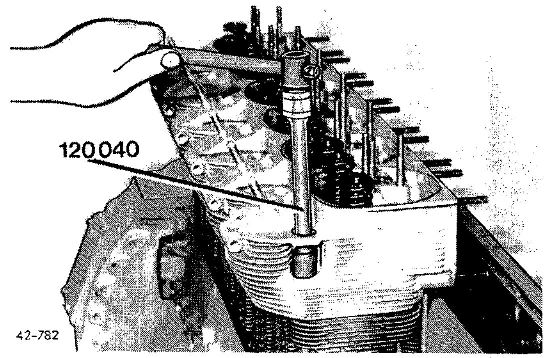
9-201

50. Slacken and remove big-end bearing cap.
Fig. 9-202

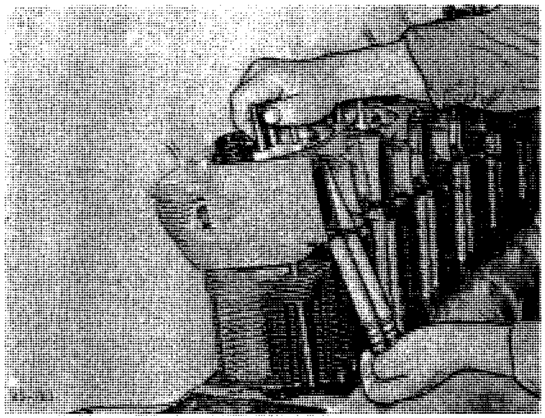


9-202

51. Loosen cylinder head bolts in stages, cross-wise.
Fig. 9-203

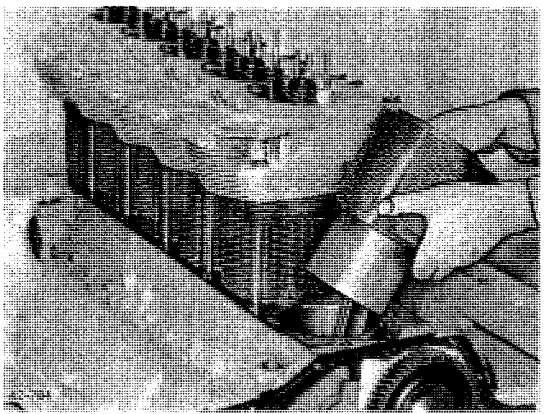


9-203



9-204

52. Take off cylinder head and pushrod cover tubes.
Fig. 9-204

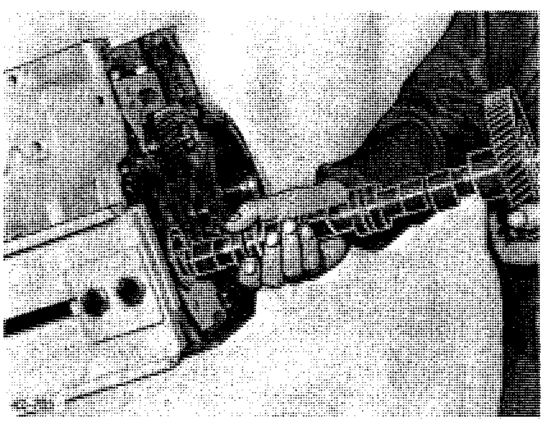


9-205

53. Withdraw cylinder together with piston and connecting rod out of crankcase.

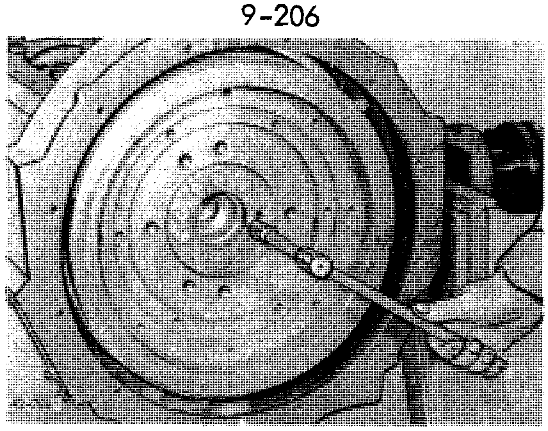
Note:

Remove the remaining cylinder units in the sequence of operations as described.
Fig. 9-205



9-206

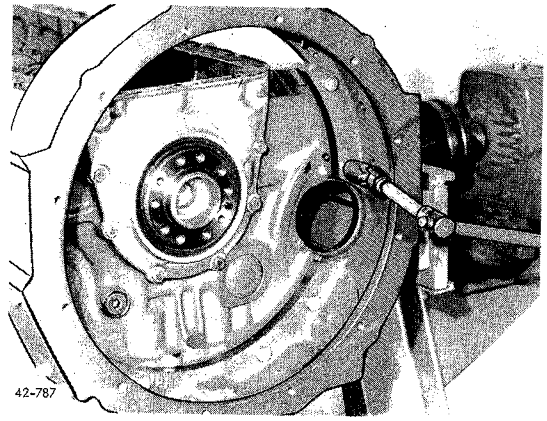
54. Turn engine on assembly stand by 180°. Withdraw camshaft.
Fig. 9-206



55. Remove flywheel.
Fig. 9-207

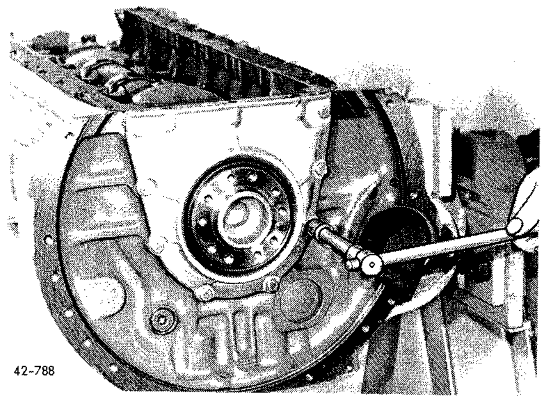
9-207

56. Remove adapter housing.
Fig. 9-208



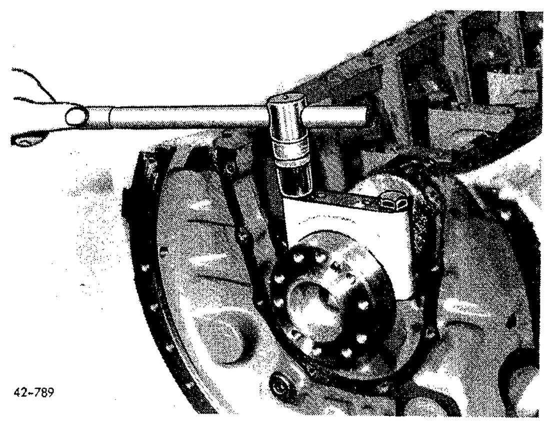
9-208

57. Remove rear cover.
Fig. 9-209



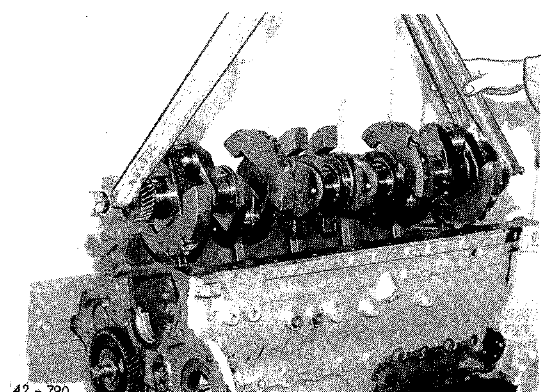
9-209

58. Screw out bolts at bearing caps. Take off bearing caps.
Fig. 9-210

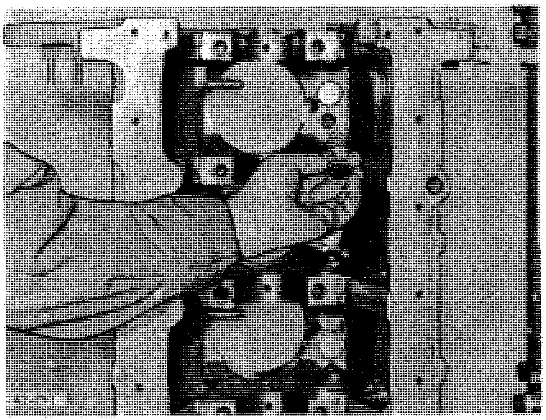


9-210

59. Lift crankshaft out of bearing lane. Take bearing shells out of bearing caps and out of crankcase.
Fig. 9-211



9-211



9-212

60. Take out tappets.

Note:

If necessary, remove piston cooling nozzles. See Chapter 4.
Fig. 9-212

REASSEMBLING ENGINE
- Driving Machinsm -

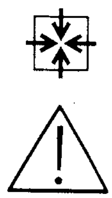
Special tools required:

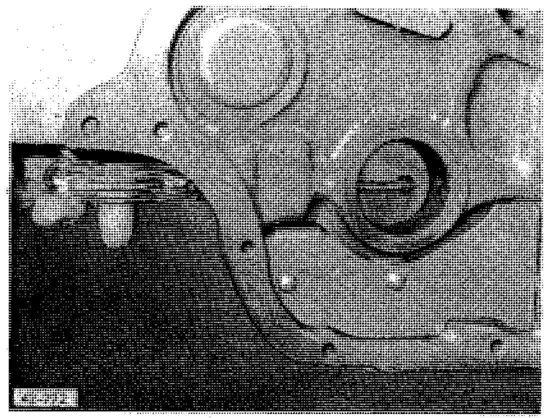
Degree gauge .... No. 101910
Device .... No. 110340
Retainer .... No. 143400
Press-in device ...... No. 143610
Special device .... No. 151100

The bearing bush of the front camshaft bore is installed. See Chapter 4.

1. Screw the oil dosing plugs into the ducts of the bearing webs.
Fig. 9-213

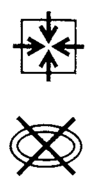
Note:
For Installation of bearing bush in camshaft bore see Chapter 4.

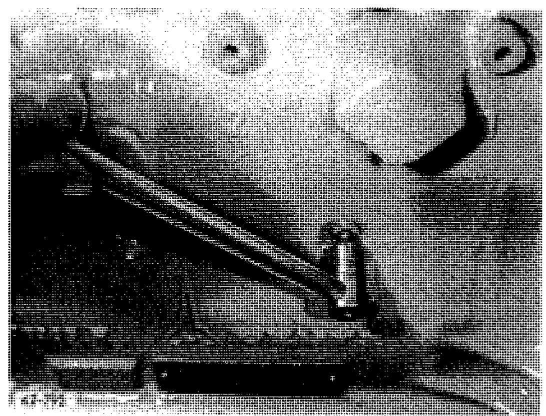




9-213

2. Screw in blanking plugs c/w new sealing rings.
Fig. 9-214

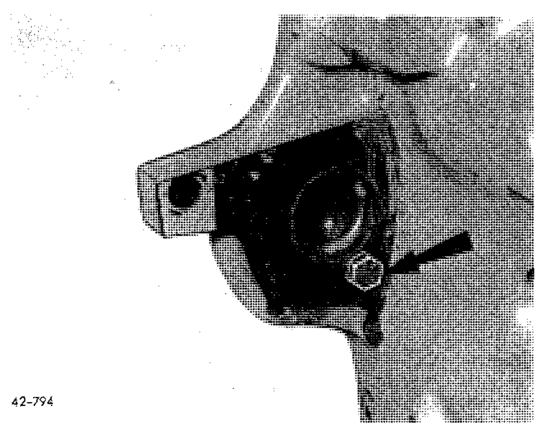




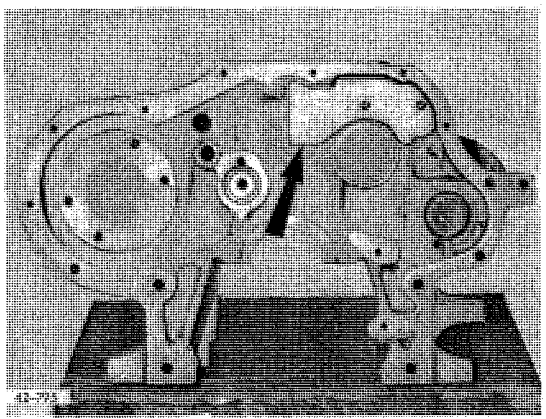
9-214

3. Only on engines without hydraulic pump:

Install core hole cover with sealing compound and screw plug c/w sealing ring.
Fig. 9-215

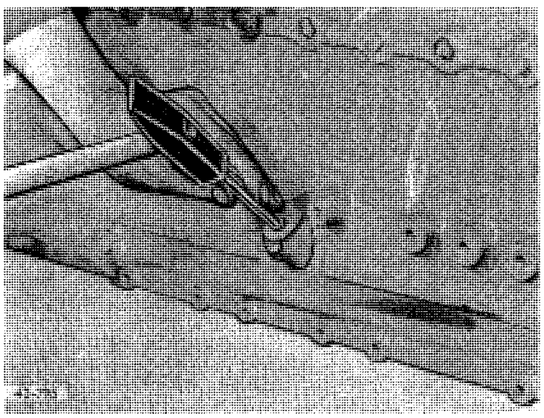


9-215



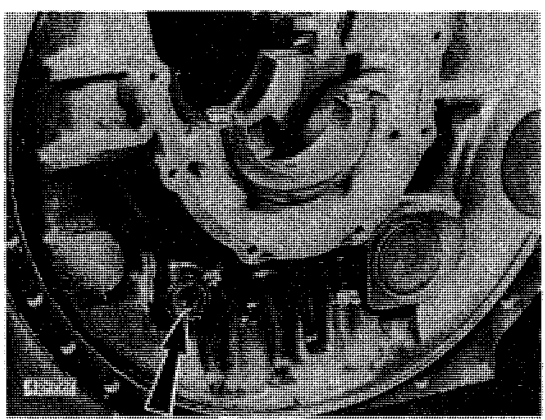
9-216

4. Check deflector plate, renew if necessary.
Fig. 9-216



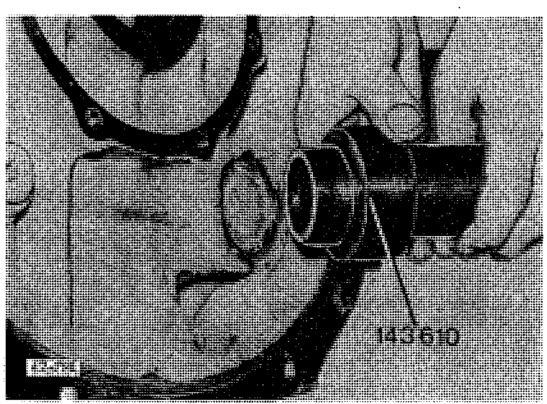
9-217

5. Fit new dipstick guide if missing or damaged. Drive in to final position.
Fig. 9-217



9-218

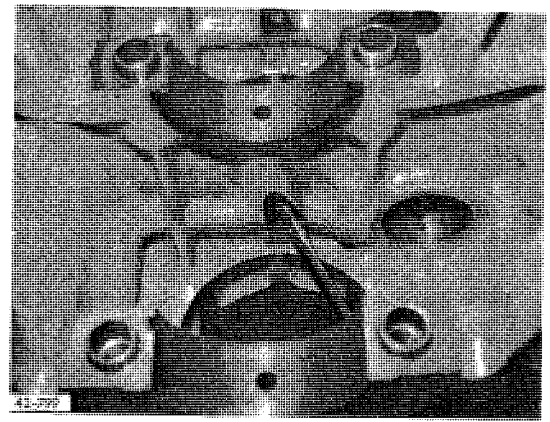
6. Screw in plug for oil gallery, c/w new sealing ring.
Fig. 9-218



9-219

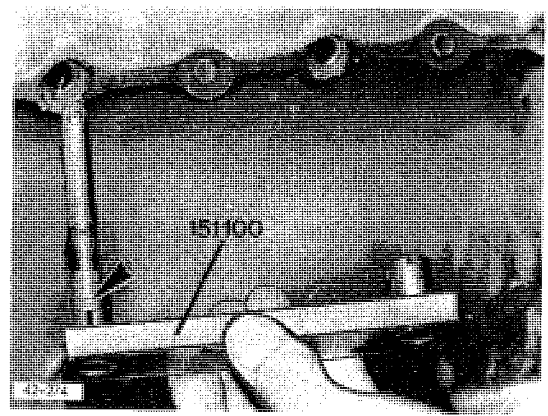
7. Insert cover of camshaft bore with sealing compound, and secure.
Fig. 9-219

8. Screw piston cooling nozzles into bearing webs.
Fig. 9-220



9-220

9. In the case of F4L 912, FL 913 and BFL 913, install horizontal piston cooling nozzles by means of special device.
Fig. 9-221

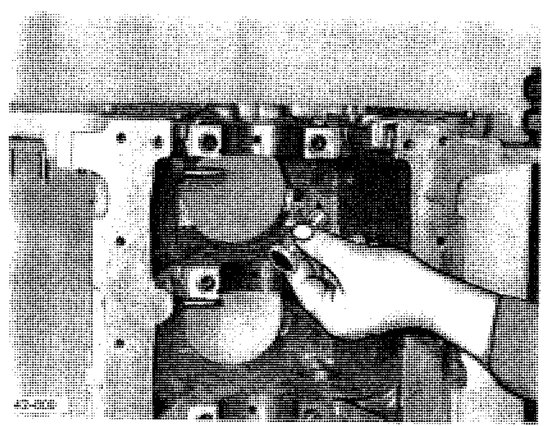


9-221

Note:

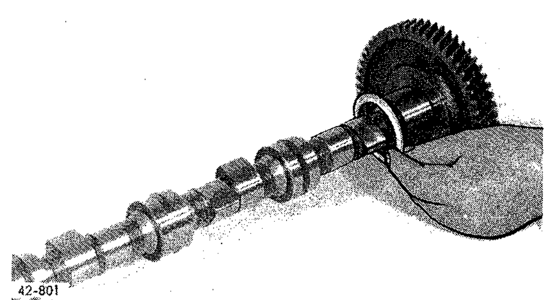
For removing and refitting piston cooling nozzles - horizontal arrangement - see Chapter 4.

10. Oil tappets and insert in crankcase.
Fig. 9-222

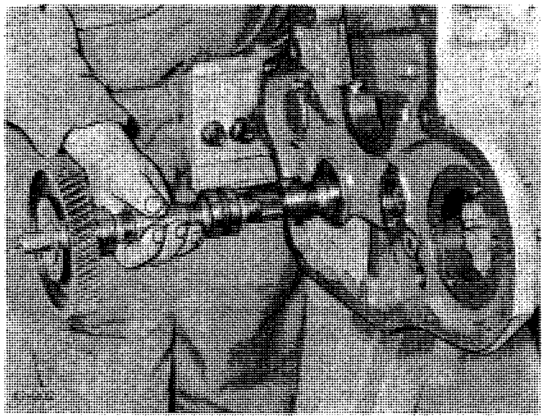


9-222

11. Place stop washer in position on camshaft.
Fig. 9-223

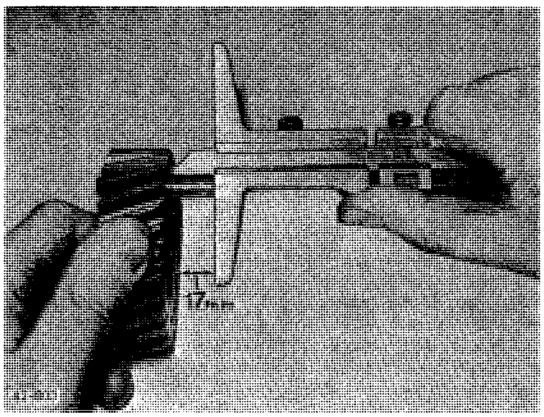


9-223



9-224

12. Oil journals of camshaft and guide camshaft into the bearing bores.
Fig. 9-224

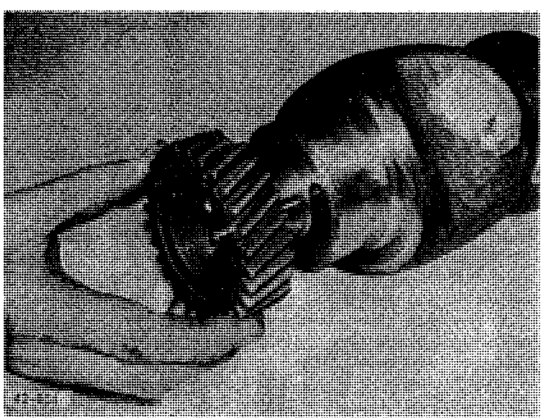


9-225

13. Check dowel pin in crankshaft gear. Projection: 17 mm.

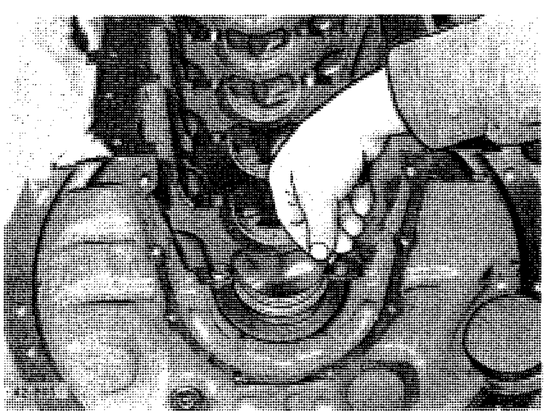
Note:

Pnchmark of gear is located on the shorter end of dowel pin.
Fig. 9-225



9-226

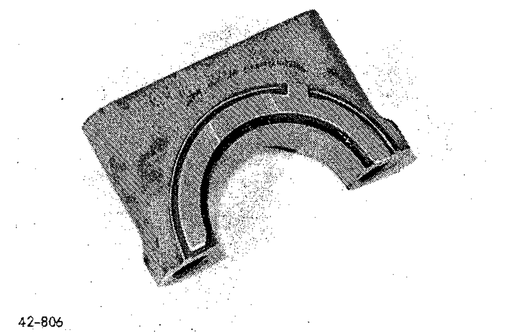
14. Push on crankshaft gear (drive on if necessary).
Fig. 9-226



9-227

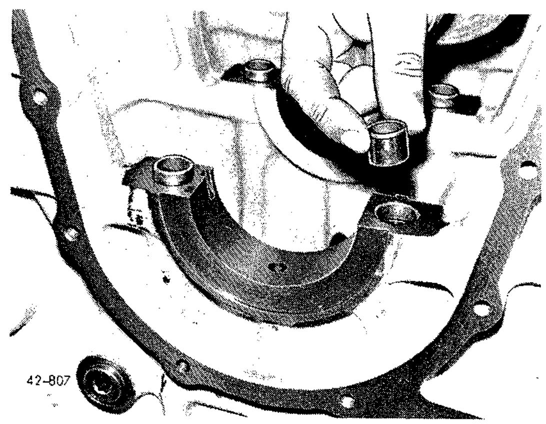
15. Place bearing shells in position in crankcase and in bearing caps.
Fig. 9-227

16. Locating bearing:
Affix stop half-rings in place with grease on the smooth faces on bearing web and bearing cap.
Fig. 9-228



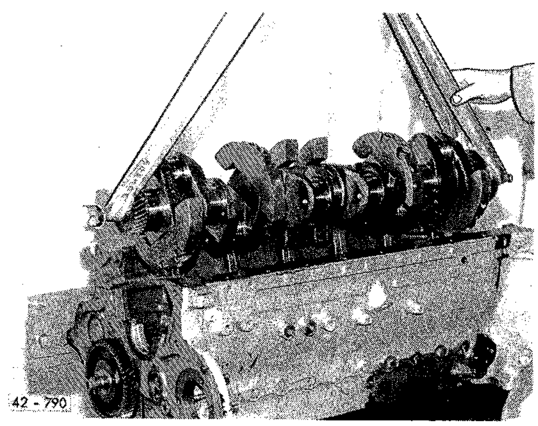
9-228

17. Insert 2 dowel sleeves at each bearing web.
Fig. 9-229



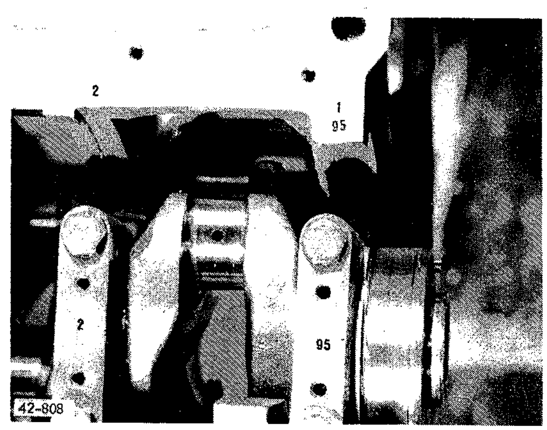
9-229

18. Oil crankshaft journals and place crankshaft in position.
Fig. 9-230

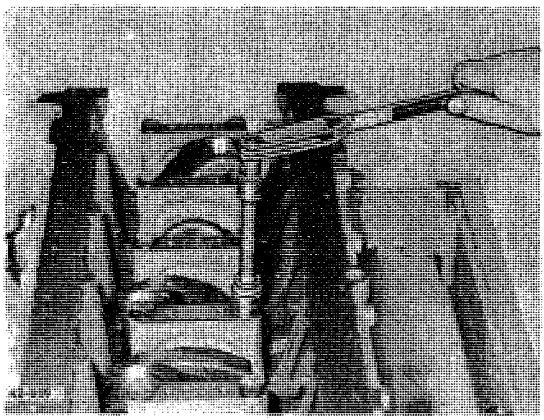


9-230

19. Mount bearing caps, noting that all identification numbers are readable in the same direction.
Fig. 9-231

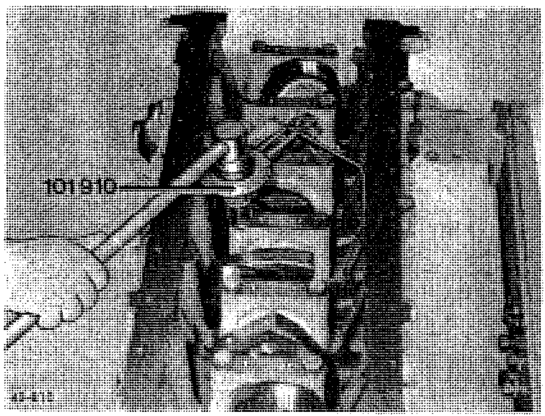


9-231



9-232

20. Pre-load main bearing bolts as specified.
Fig. 9-232

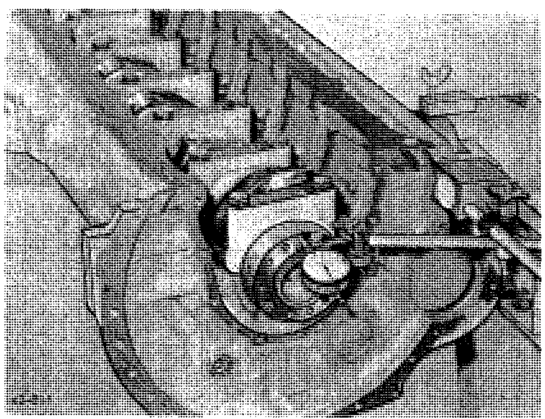


9-233

21. Tighten main bearing bolts as specified.

Note:

Beginning at the middle cap, tighten main bearing bolts successively outwards. The crankshaft must be freely rotatable.
Fig. 9-233



9-234

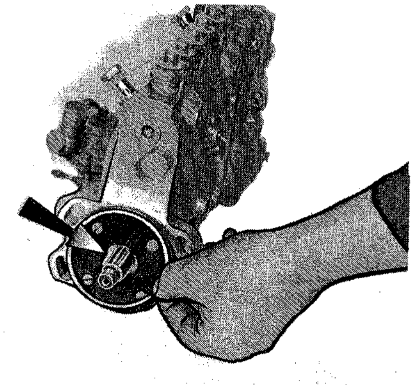
22. Mount magnetic stand with dial gauge. Measure end float of crankshaft.

Note:

Correct the end float by using stop rings of appropriate thickness.
Fig. 9-234

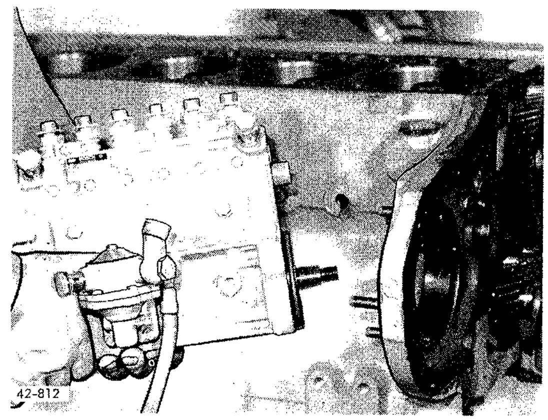
MOUNTING INJECTION PUMP

23. Insert Woodruff key. Fit new O-seal.
Fig. 9-235


42-474

9-235

24. Mount injection pump.
Fig. 9-236

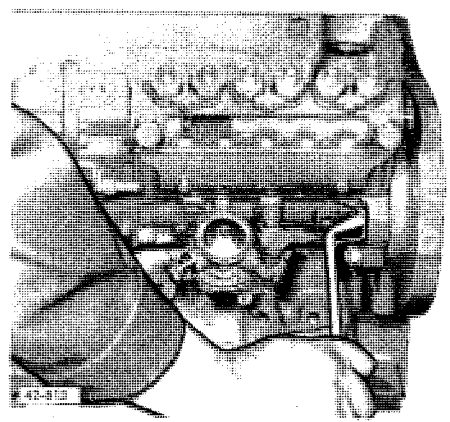

42-812

9-236

25. Fasten nuts at flange of injection pump.

Note:

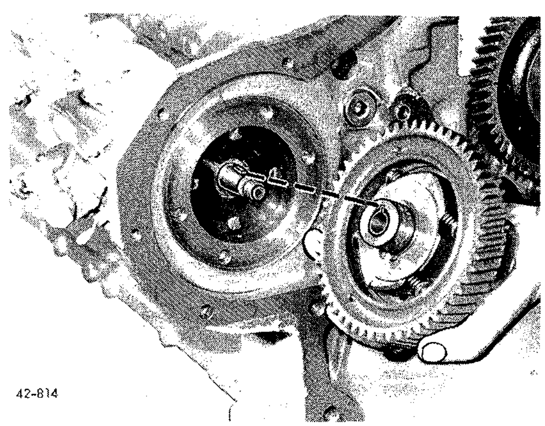
Elongated holes at middle position.
Fig. 9-237



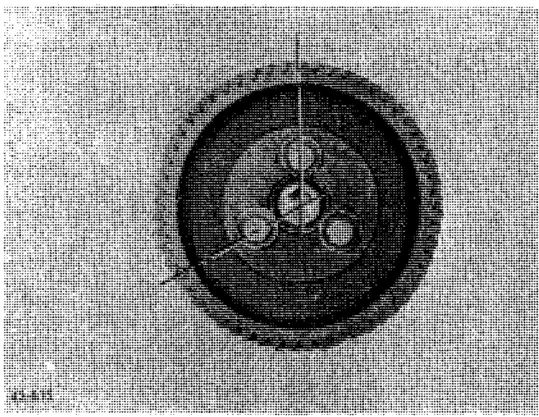
9-237

26. Engines with advance/retard unit:

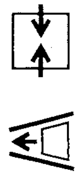
Align keyway of advance/retard unit with Woodruff key and push on unit. Screw on clamping nut loosely.
Fig. 9-238


42-814

9-238

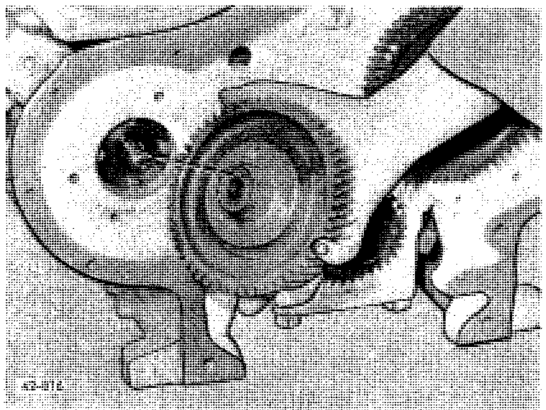


9-239

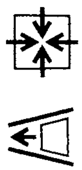


27. Engines without advance/retard unit:

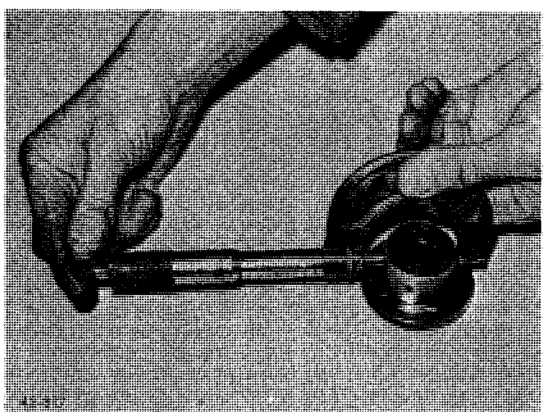
Assemble gear aligned with hub. The Woodruff keyway must face towards upper gear marking.
Fig. 9-239



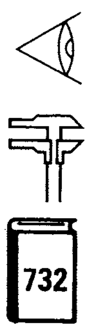
9-240



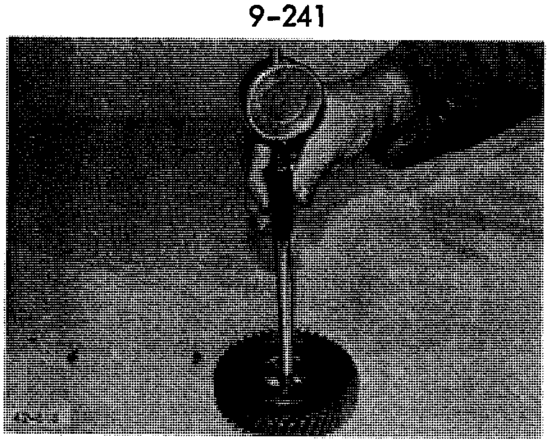
28. Align keyway of hub/gear assembly with Woodruff kay and push on assembly. Screw on nut loosely.
Fig. 9-240



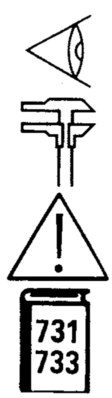
9-241



29. Inspect journal for idler gear and gauge journal.
Fig. 9-241



9-242

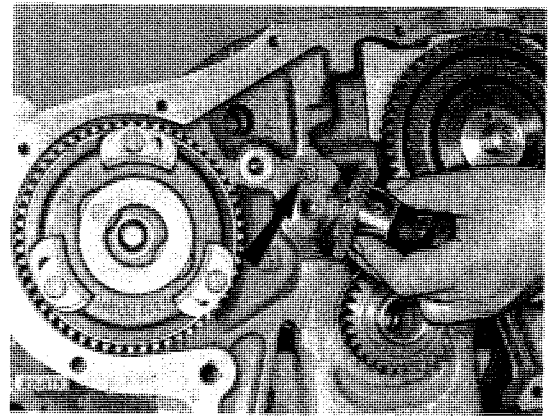


30. Inspect idler gear and gauge bearing bore.

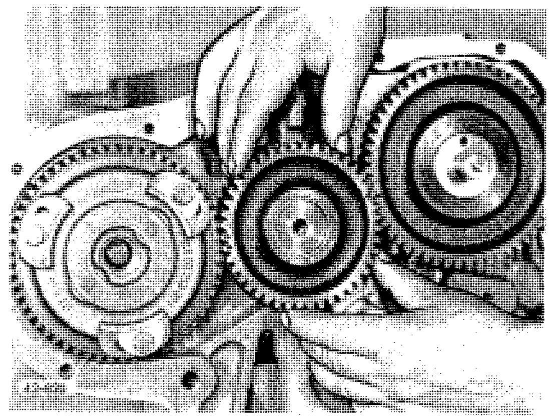
Note:

The difference between the bearing bore and the journal diameter is the radial clearance.
Fig. 9-242

31. Insert dowel sleeve. Oil journal for idler gear and install.
Fig. 9-243

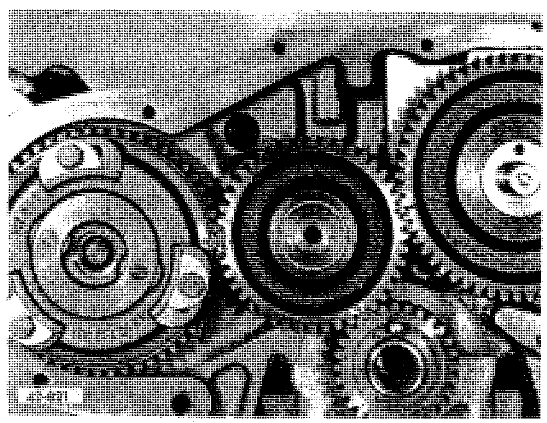

9-243

32. Mate gears according to markings and push on idler gear.
Fig. 9-244


9-244

33. On 3-cylinder engines only:

The tooth of the injection pump gear marked with <u>two</u> punchmarks is engaged with the idler gear.
Fig. 9-245

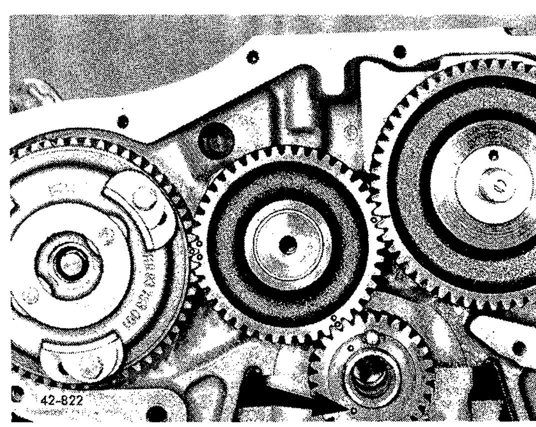

9-245

34. On 4- to 6-cylinder engines:

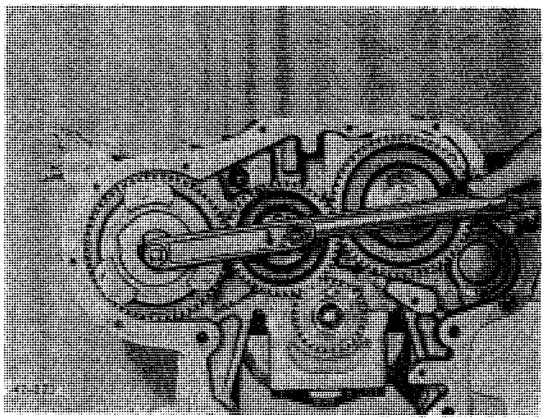
The tooth of the injection pump gear marked with <u>one</u> punchmark is engaged with the idler gear.

<u>Note</u> for 4-cylinder engines with mass balancing gear (MAG):

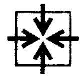
The punchmark (arrow) on the crankshaft gear is intended for the basic setting of the MAG front-end drive.
Fig. 9-246

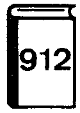


9-246

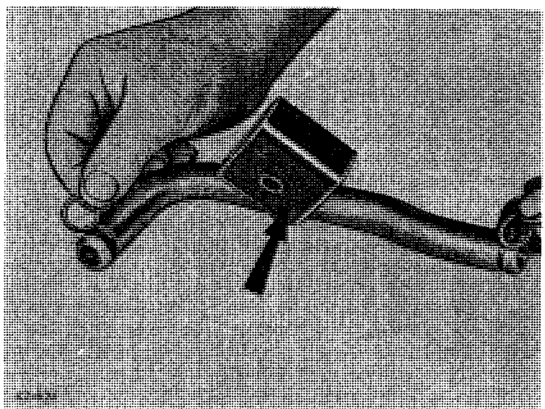


9-247

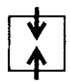




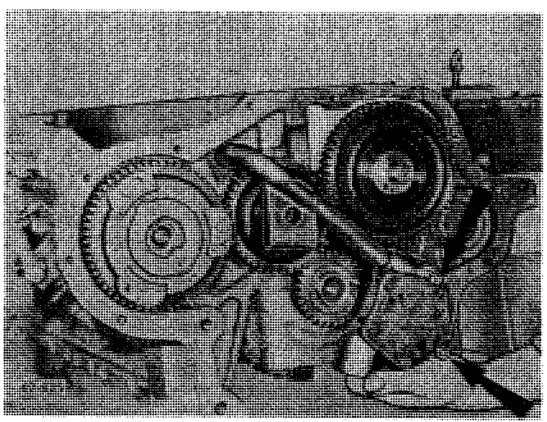
35. Tighten nut at injection pump drive as specified.
Fig. 9-247



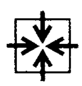
9-248



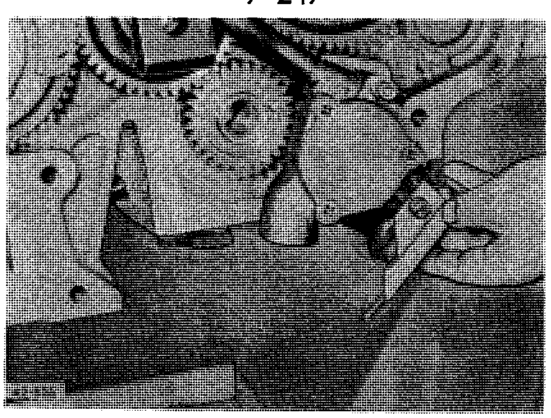
36. Fit new O-seals and clamping yoke on delivery pipe of oil pump.
Fig. 9-248

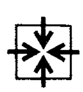


9-249



37. Position oil pipe with oil pump on crankcase. Tighten fastening botls for lube oil pump as specified.
Fig. 9-249

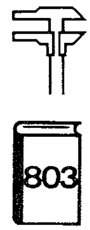


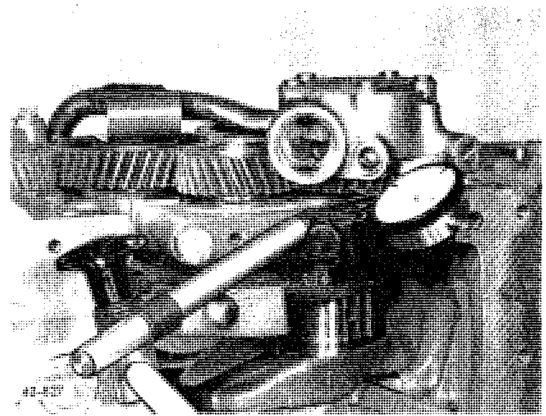


On F5/6L 912 enignes only:
Mount deflector plate.
Fig. 9-250

9-250

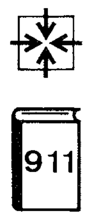
38. Adjust backlash of teeth.
Fig. 9-251

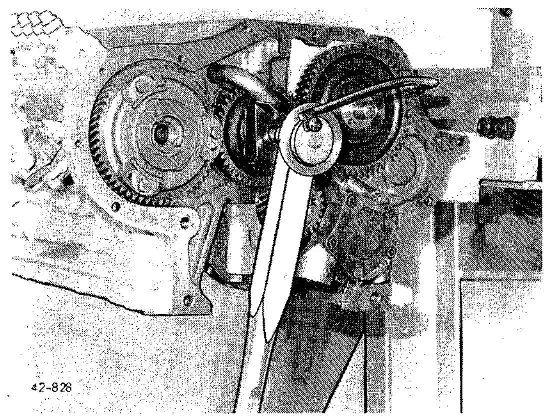




9-251

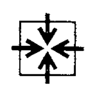
39. Tighten as specified bolt for idler gear bearing at clamping yoke of oil pipe.
Fig. 9-252

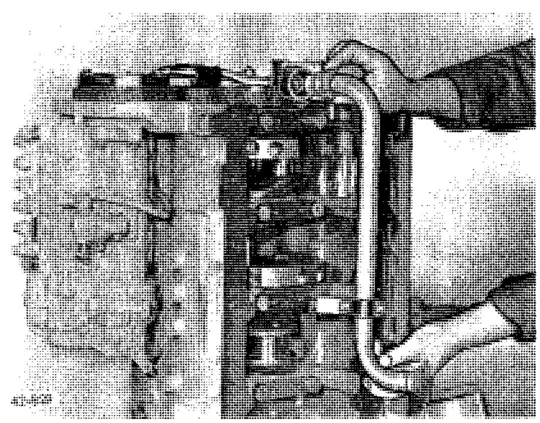




9-252

40. Mount suction pipe of oil pump.
Fig. 9-253



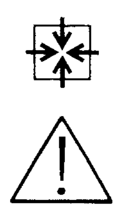


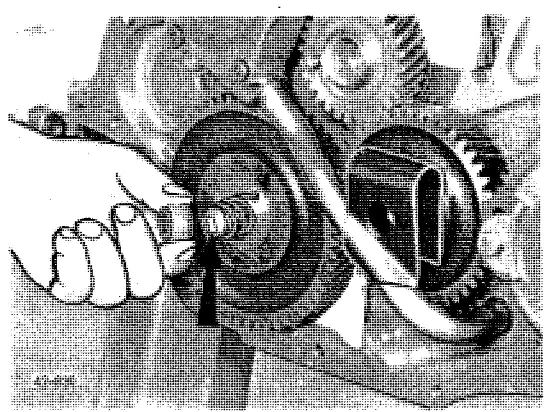
9-253

41. Place compression spring and thrust cap on camshaft spigot.

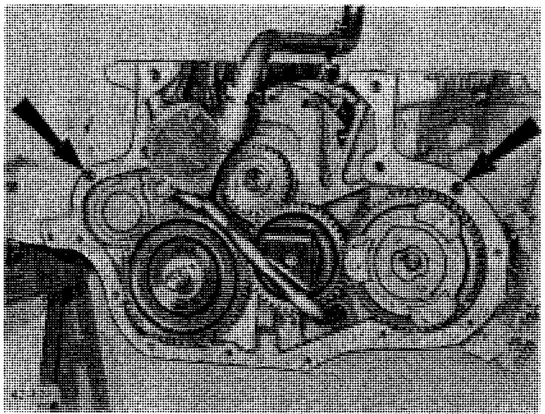
Note:

Camshaft has driving tongue for angle drive in case of tachometer installation. See arrow.
Fig. 9-254



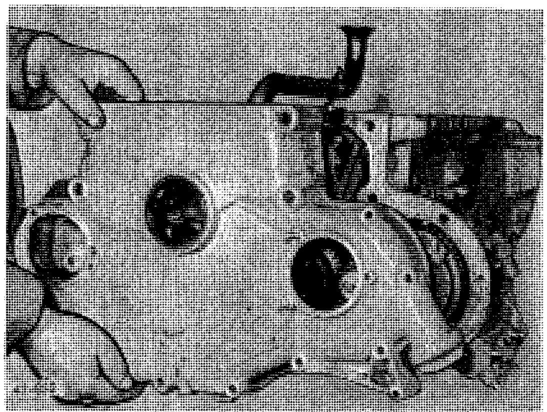


9-254



9-255

45. Substitute missing dowel sleeves. Affix gasket for front cover with grease.
Fig. 9-255

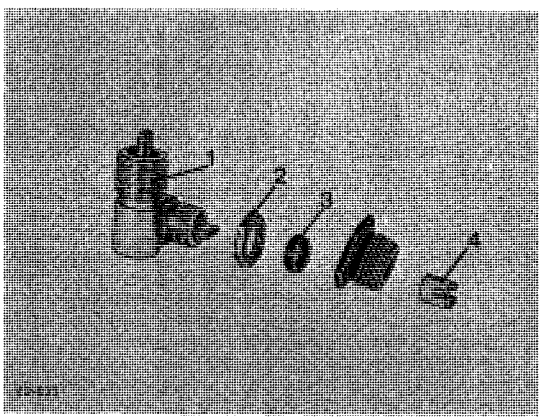


9-256

46. Mount front cover.

Note:

Ensure proper guidance of thrust cap of camshaft!
Fig. 9-256

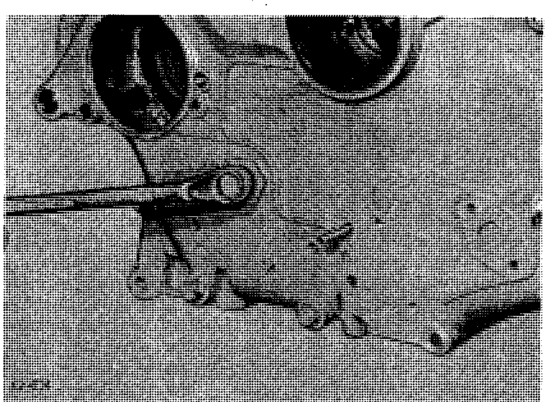


9-257

ANGLE DRIVE FOR TACHOMETER

Components of the angle drive:

1 - Angle drive
2 - Lock nut
3 - Guide bush
4 - Driver
Fig. 9-257



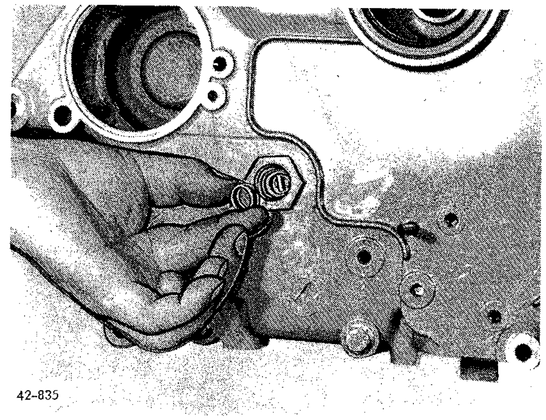
9-258

47. Screw out plug.
Fig. 9-258

Note:

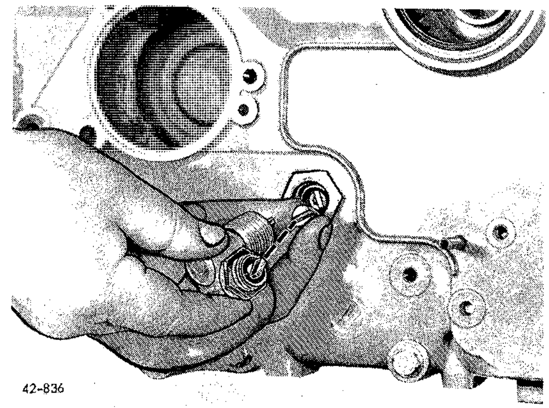
Bore must be available for receiving the driving tongue in the camshaft.
Fig. 9-254

48. Insert guide bush -3-.
Fig. 9-259



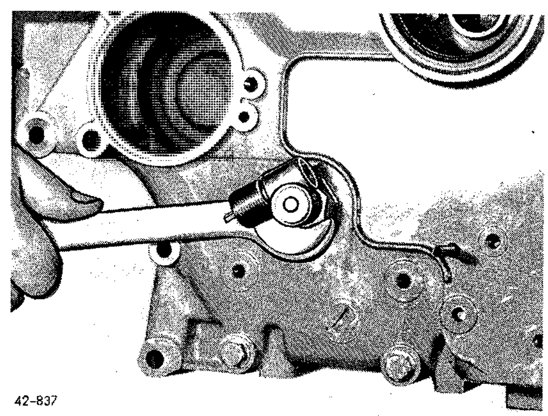
9-259

49. Position and introduce driver -4- and angle drive -1- together with lock nut -2-.
Fig. 9-260



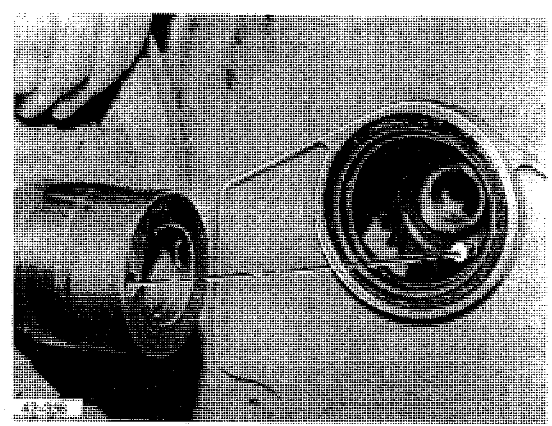
9-260

50. Adjust position of angle drive and tighten lock nut.
Fig. 9-261

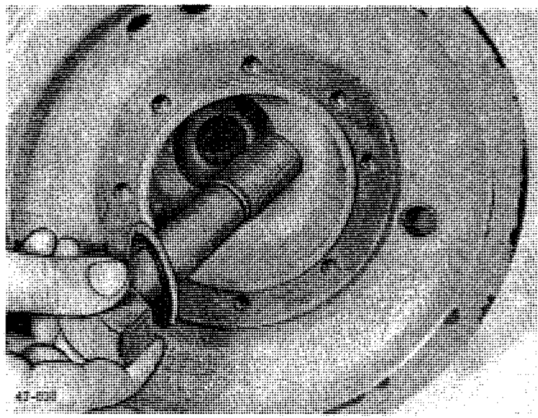


9-261

51. Grease sealing lip of shaft seal and journal of V-belt pulley. Mount pulley.
Fig. 9-262



9-262

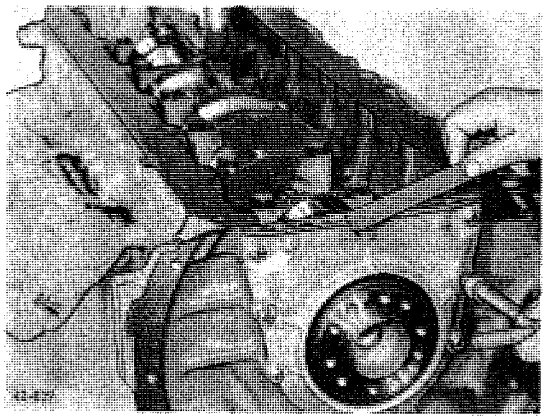


9-263

52. Screw in bolt for V-belt pulley c/w washer and pre-load lightly.

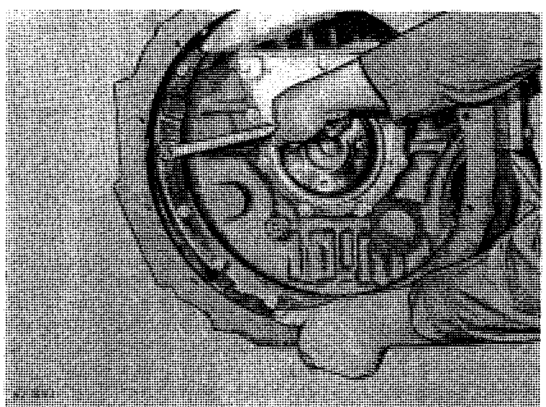
Note:

Bolt has left-hand thread!
Fig. 9-263



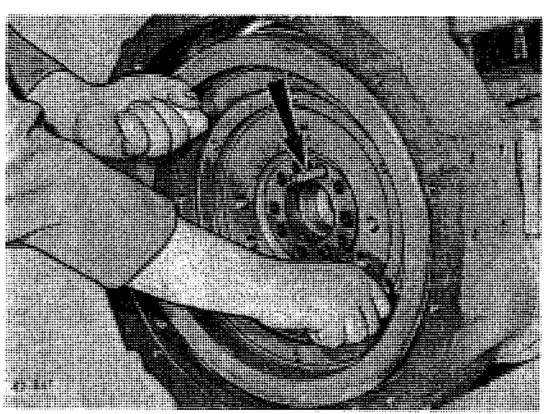
9-264

53. Affix gasket to rear cover with grease. Mount cover so that it is flush with the oil pan seating.
Fig. 9-264



9-265

54. Mount adapter housing.
Fig. 9-265



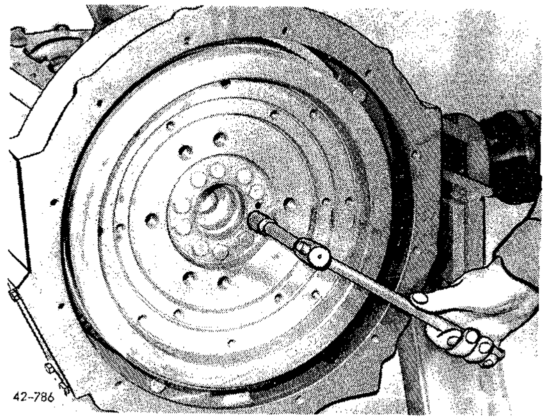
9-266

55. Position flywheel with the locating bore in line with dowel sleeve of crankshaft and slide into place over a self-prepared threaded mandrel (arrow).

Note:

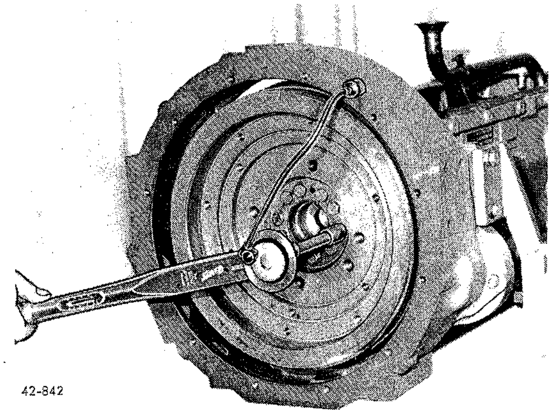
Lock crankshaft at V-belt pulley with retainer No. 143400.
Fig. 9-266

56. Screw in flywheel bolts and tighten lightly cross-wise.
Fig. 9-267



9-267

57. Finally tighten flywheel bolts as specified.
Fig. 9-268



9-268

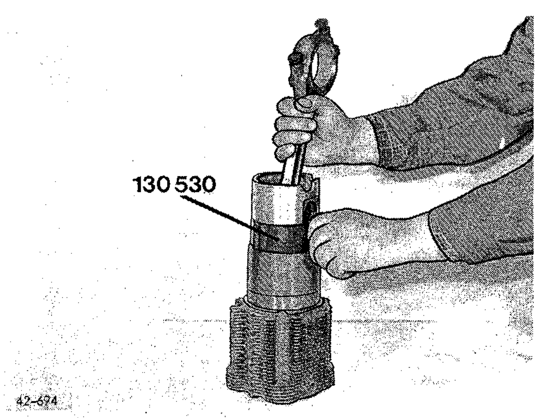
REASSEMBLING ENGINE
- Cylinder Unit -

Special tools required:

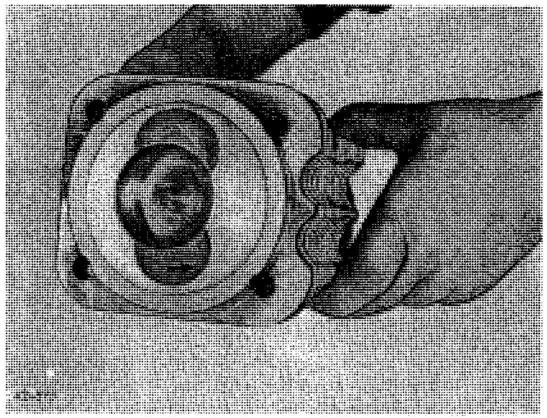
Socket wrench for
cylinder head bolts .. No. 120040
Spring compressor .... No. 125310
Piston ring clamp
FL 912 .... No. 130530
Piston ring clamp
FL 913 .... No. 130600

Piston and connecting rod are preassembled. See Chapter 3.

58. Oil cylinder. Compress piston rings with clamp.
Fig. 9-269

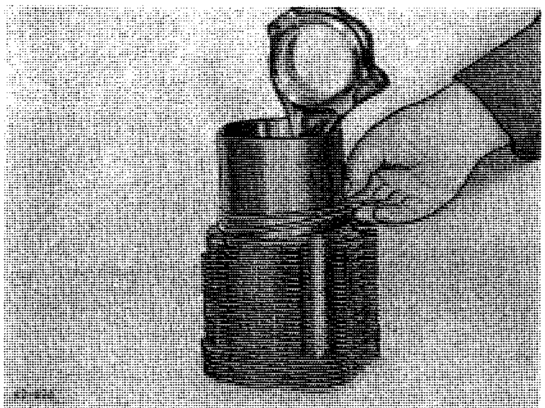


9-269



9-270

59. Introduce piston into cylinder so that the arrow for "air discharge side" points towards the recesses in cylinder for the pushrod cover tubes.
Fig. 9-270

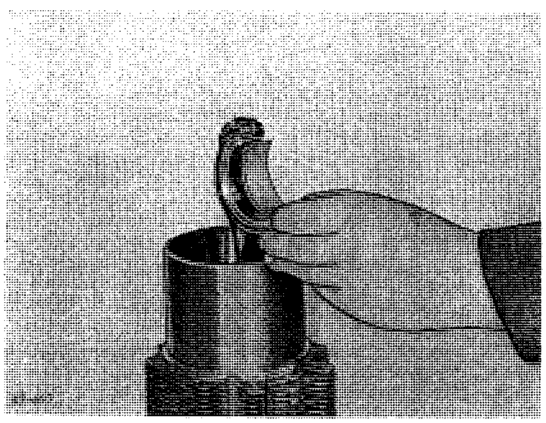


9-271

60. Affix shims in place with a little grease.

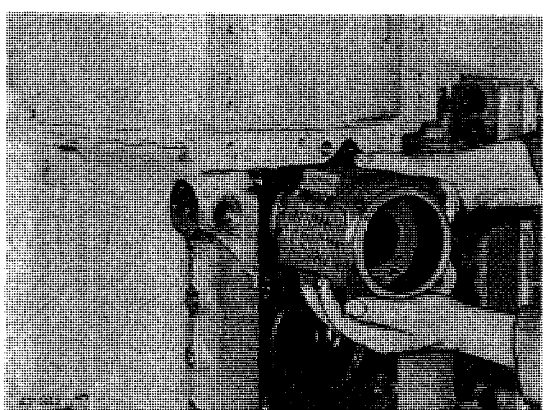
Note:

To permit correction without having to remove cylinder following piston crown celarance measurement, fit preferably three shims.
Fig. 9-271



9-272

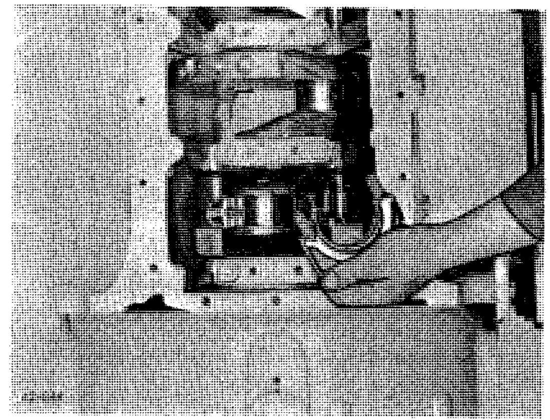
61. Fit bearing shells in connecting rod and matching bearing cap.
Fig. 9-272



9-273

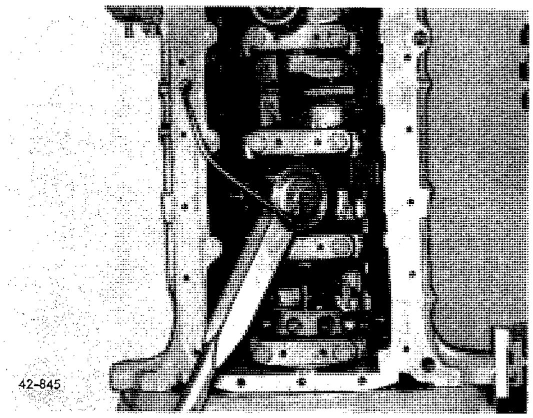
62. Insert cylinder c/w piston and connecting rod so that the arrow on piston crown points towards tappet bores.
Fig. 9-273

63. Push big-end of connecting rod carefully onto crankpin, oil big-end bearing and fit bearing cap.
Fig. 9-274



9-274

64. Insert new big-end bolts and tighten as specified.
Fig. 9-275

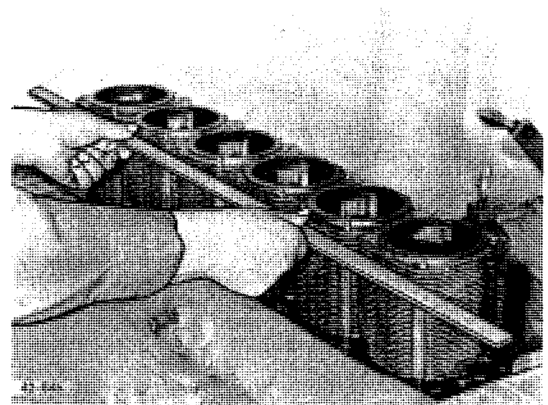


9-275

65. Align cylinders.

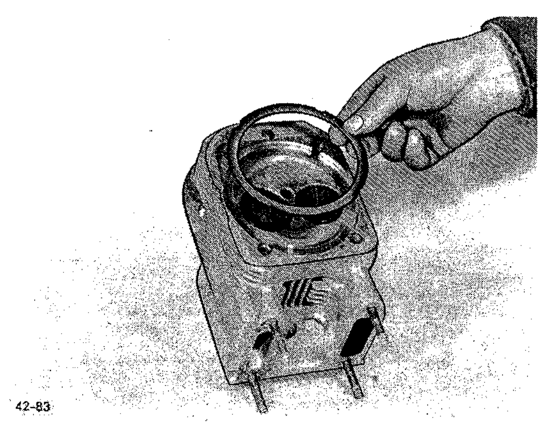
Note:

Check/adjust piston crown clearance. See Chapter 2.
Fig. 9-276

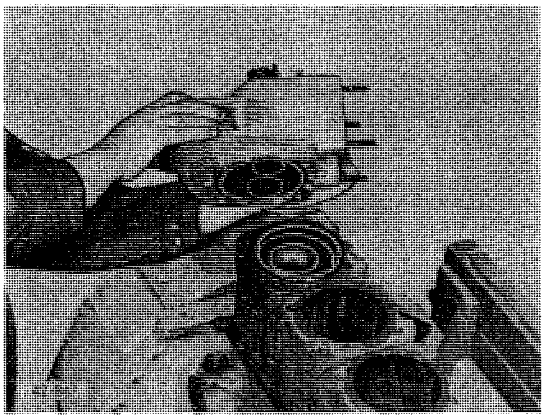


9-276

66. Place on intermediate rings, lightly affixing with grease if necessary.
Fig. 9-277

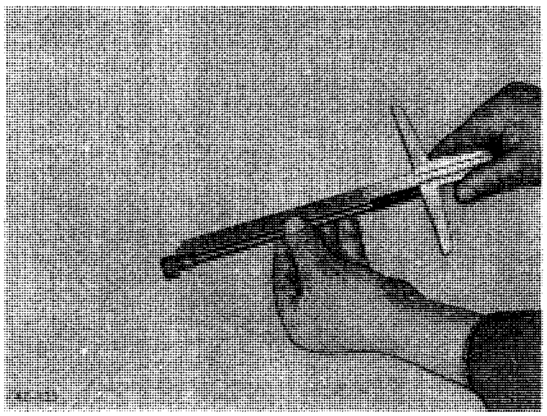


9-277



9-278

67. Place on cylinder heads.
Fig. 9-278



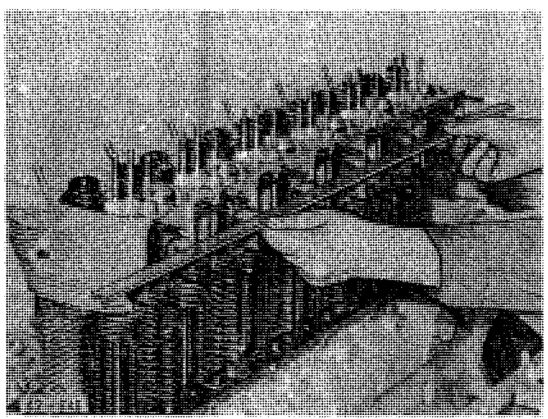
9-279

68. Measure lenght of cylinder head bolts.

Note:

Renew cylinder head bolts if strechted.
Fig. 9-279

281

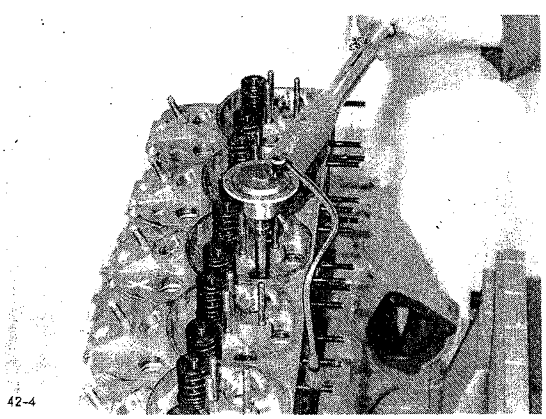


9-280

69. Insert cylinder head bolts c/w washers, with threads lightly oiled. Align cylinder heads.

Note:

Pay attention to variation of washers. See Technical Circular.
Fig. 9-280

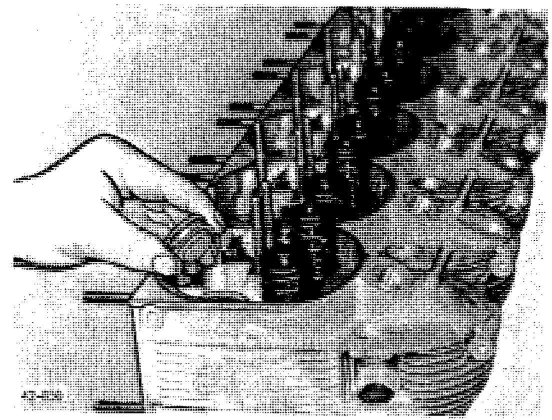


9-281

70. Tighten cylinder head bolts as specified.
Fig. 9-281

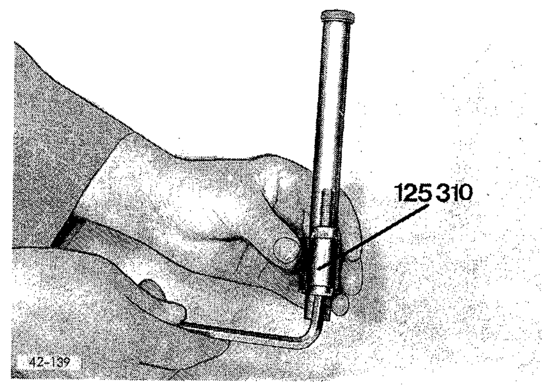
902

71. Insert plugs c/w sealing rings and tighten as specified.
Fig. 9-282



9-282

72. Fit spring on pushrod cover tube and compress with tool.
Fig. 9-283



9-283

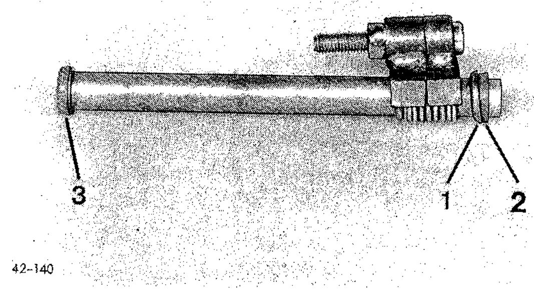
73. Preassemble pushrod cover tube.

Assembly sequence:

1. Profile washer
2. Lower profile seal
3. Upper profile seal

Note:

Always renew profile seals.
Fig. 9-284

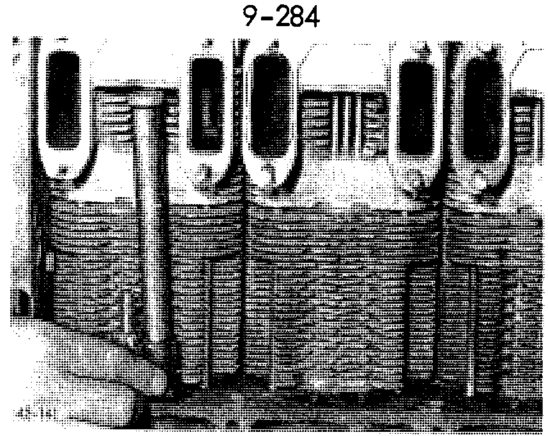


9-284

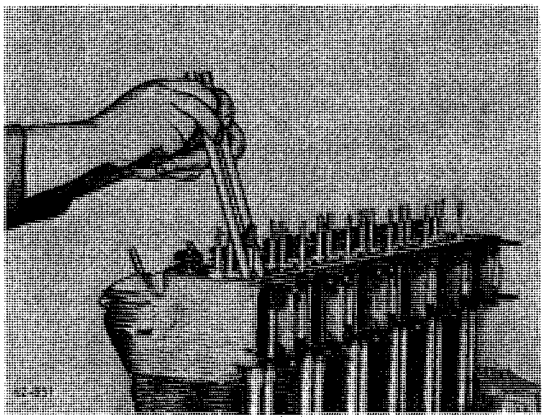
74. Introduce pushrod cover tube first into the crankcase and then into the cylinder head. Withdraw spring compressor.

Note:

For installing the pushrod cover tubes in case of air-to-air heating system, see Chapter 3.
Fig. 9-285



9-285

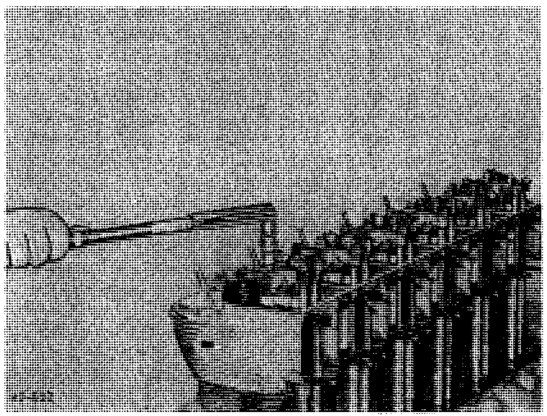


9-286

75. Insert pushrods.

Note:

Pay attention to variation of pushrod lengths. See Technical Circular.
Fig. 9-286



9-287

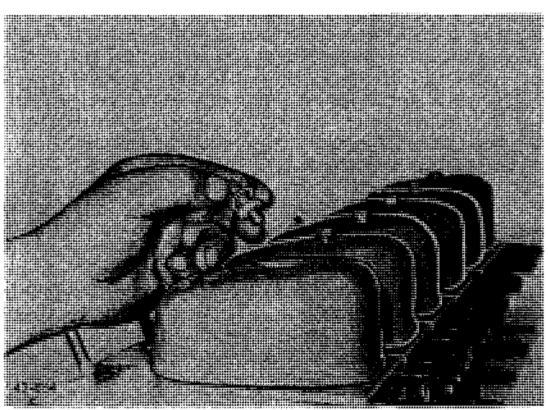
76. Fit rocker arm brackets and tighten nuts as specified.

Note:

Set valve clearance.
See Chapter 2.
Fig. 9-287

9-288

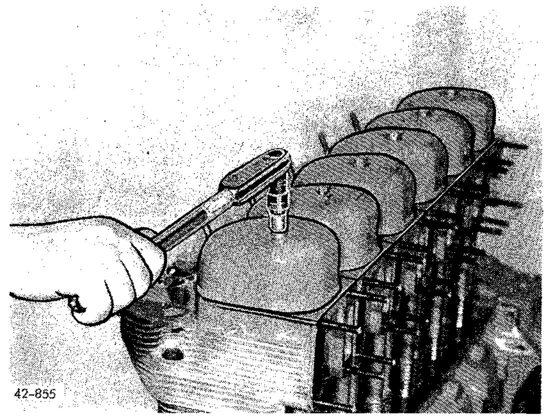
77. Affix gasket with sealing compound, the graphited surface facing towards cylinder head.
Fig. 9-288



9-289

78. Fit rocker chamber covers and insert bolts c/w joint washers.
Fig. 9-289

79. Tighten bolts as specified.
Fig. 9-290

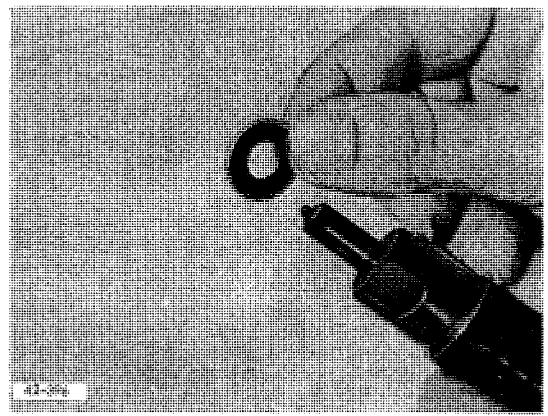


9-290

80. Affix special sealing ring with a little grease on graphited side onto injector.

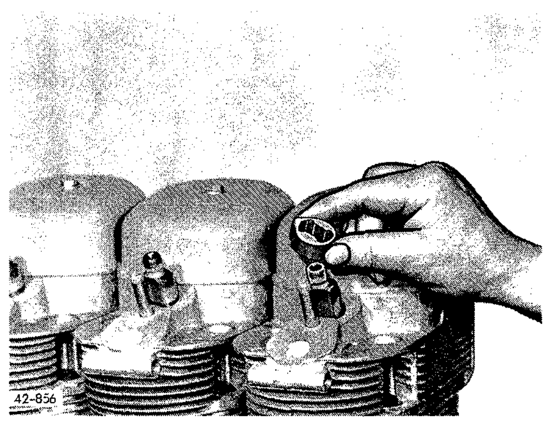
Note:

Installation of injector in case of 2-stage combustion: See Chapter 7.
Fig. 9-291



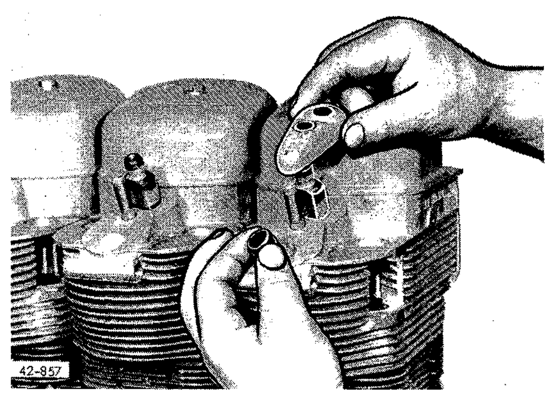
9-291

81. Install injector. Insert guide piece.
Fig. 9-292

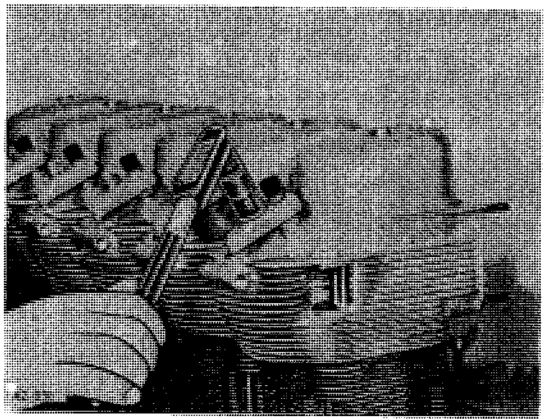


9-292

82. Place on thrust piece and clamping bridge.
Fig. 9-293

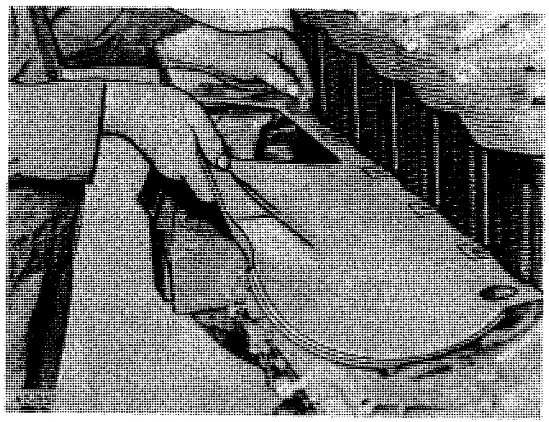


9-293



9-294

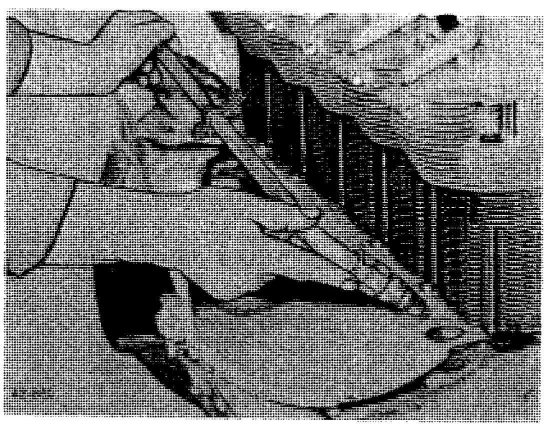
83. Screw on hex. nut for fastening injector and tighten as specified.
Fig. 9-294



9-295

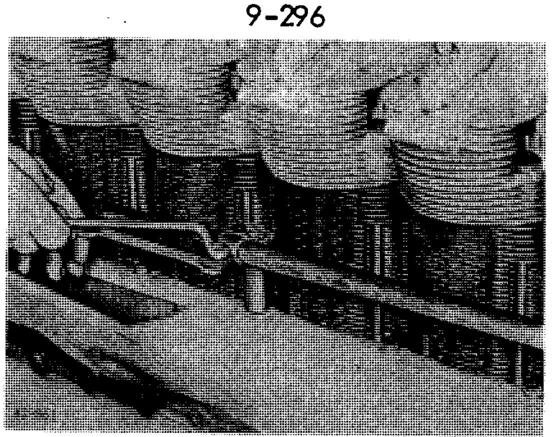
FINAL ASSEMBLY OF ENGINE

84. Mount air cowling bottom part.
Fig. 9-295



9-296

85. Mount lube oil connecting pipe.
Fig. 9-296

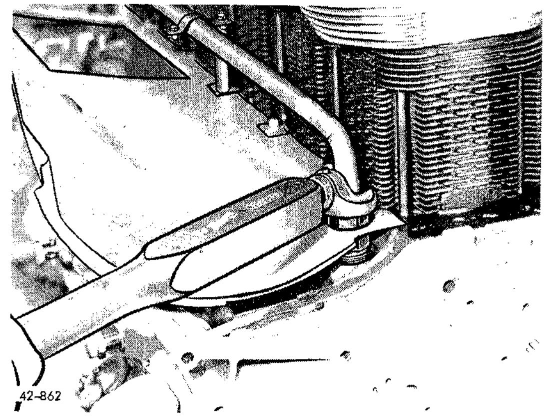


9-297

86. Fasten lube oil connecting pipe with clip.
Fig. 9-297

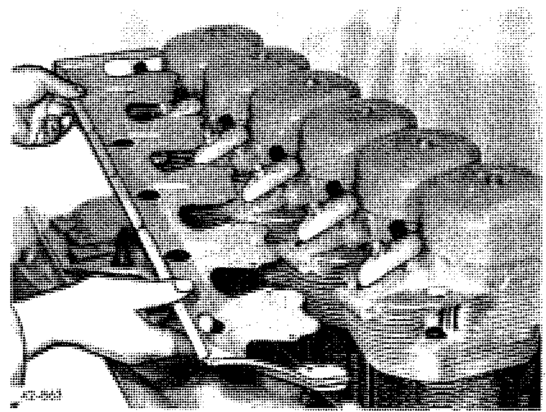
87. Tighten cap screws for cutting-ring joints as specified. Fig. 9-298

925



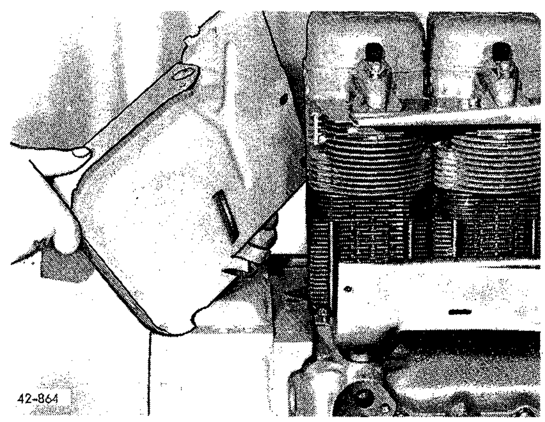
9-298

88. Mount upper cover plate. Fig. 9-299



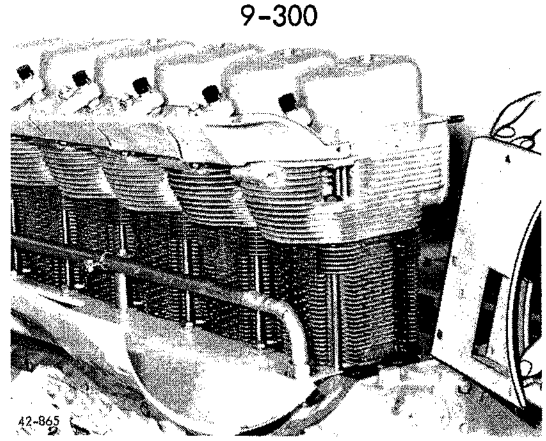
9-299

89. Mount rear stay plate, after turning in by a few threads inside bolt c/w washer. Fig. 9-300

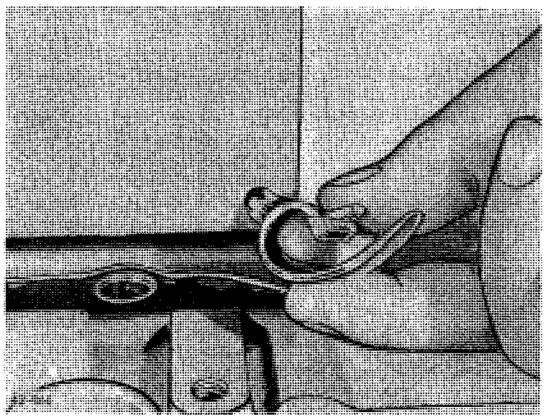


9-300

90. Mount front stay plate. Fig. 9-301

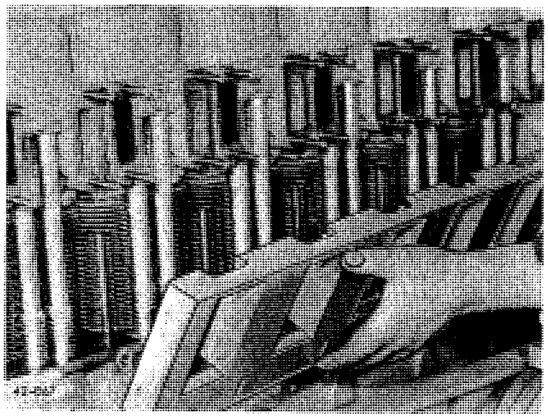


9-301



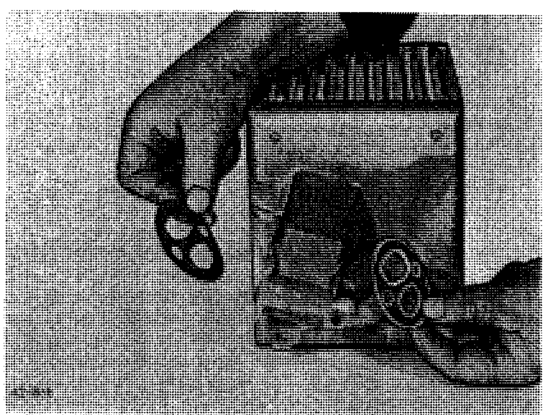
9-302

91. Insert cable fastener in front stay plate.
Fig. 9-302



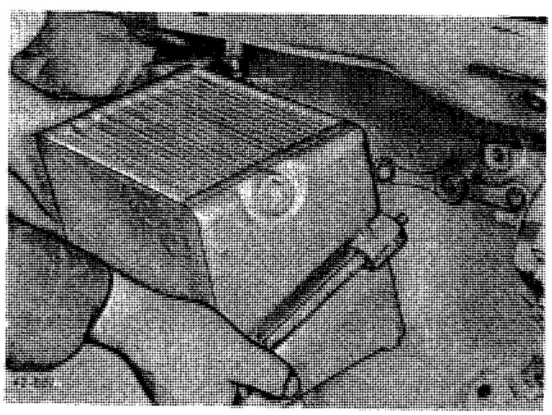
9-303

92. Mount discharge air baffle plate.
Fig. 9-303



9-304

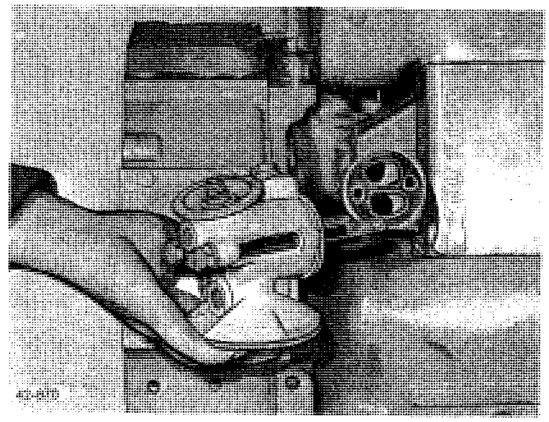
93. Affix gaskets to lube oil cooler with grease.
Fig. 9-304



9-305

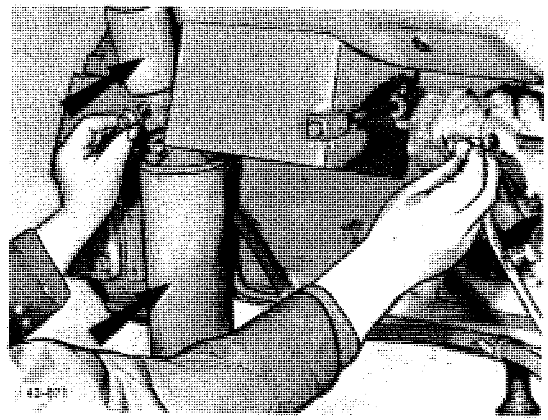
94. Place lube oil cooler in position and fasten lightly with one bolt.
Fig. 9-305

95. Mount filter bracket. Tighten uniformly bolts of filter bracket and of lube oil cooler.
Fig. 9-306



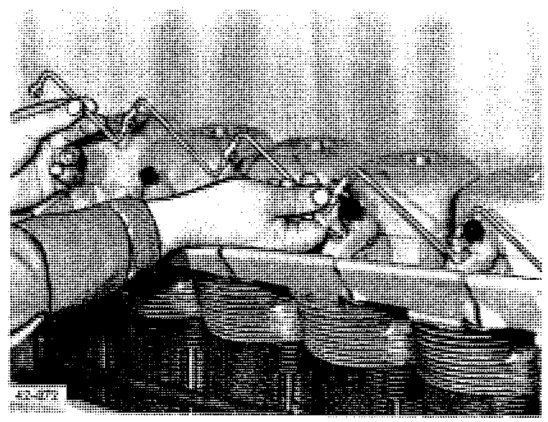
9-306

96. Screw on new filter cartridges for fuel and oil. Attach fuel lines at injection pump, feed pump and filter bracket.
Fig. 9-307



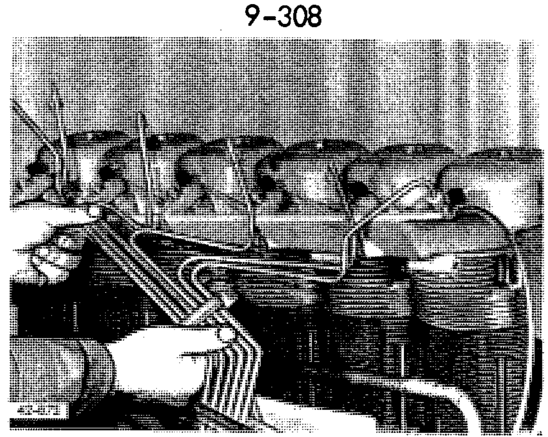
9-307

97. Mount backleakage line c/w banjo bolts and sealing rings at the injectors.
Fig. 9-308

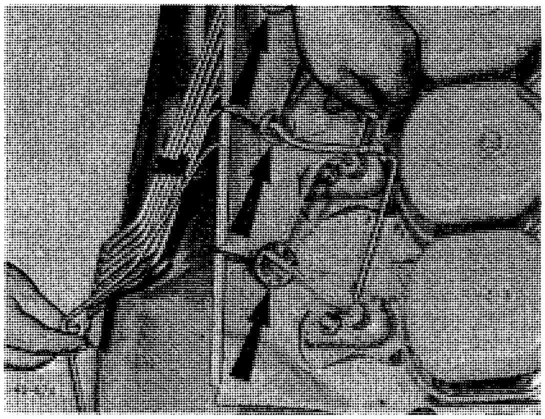


9-308

98. Mount injection lines provided with new rubber strip.
Fig. 9-309

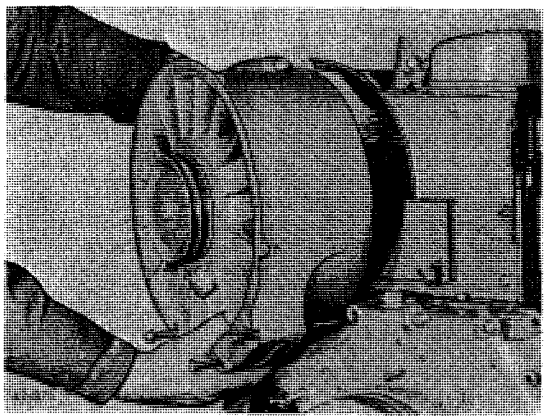


9-309



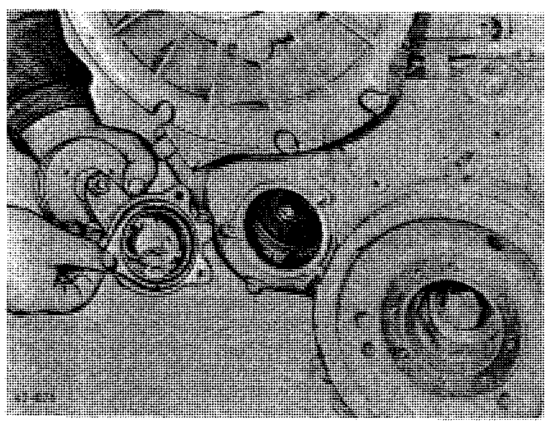
9-310

99. Mount rubber grommets and backleakage connecting pipe.
Fig. 9-310



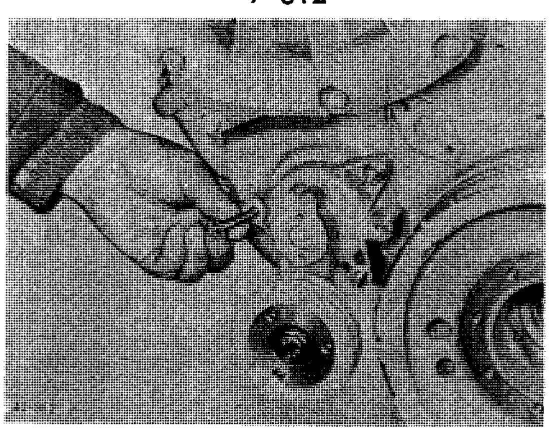
9-311

100. Mount cooling blower.
Fig. 9-311



9-312

101. Place O-seal on V-belt tensioner.
Fig. 9-312



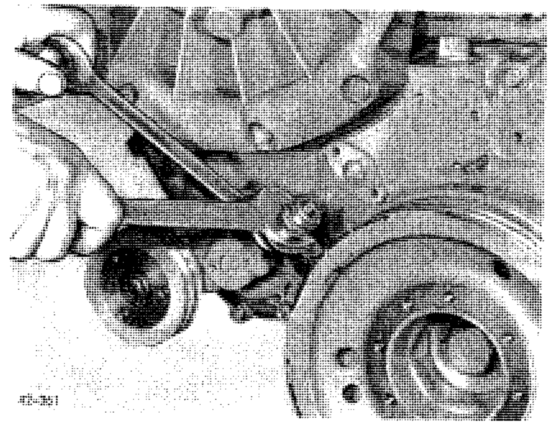
9-313

102. Fasten V-belt tensioner via two studs and one M 8 x 30 bolt.

Note:

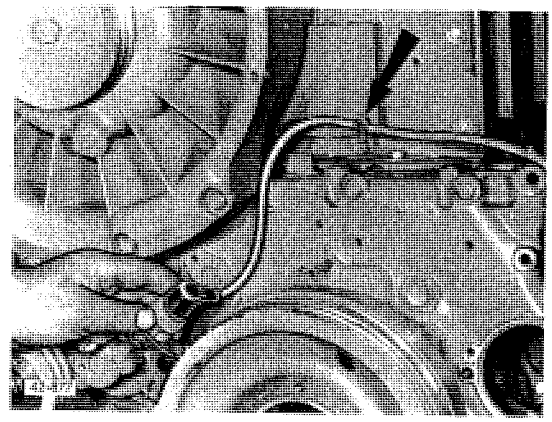
On engines without V-belt tensioner, mount cover and fasten via three studs.
Fig. 9-313

103. Screw on warning switch and fasten with lock nut.
Fig. 9-314



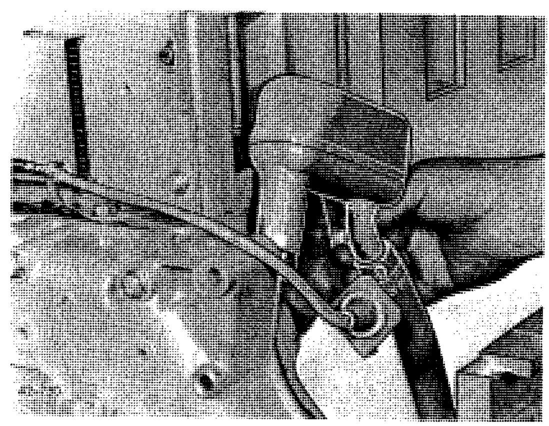
9-314

104. Secure cable for warning switch in fastener. Connect plug at warning switch.
Fig. 9-315



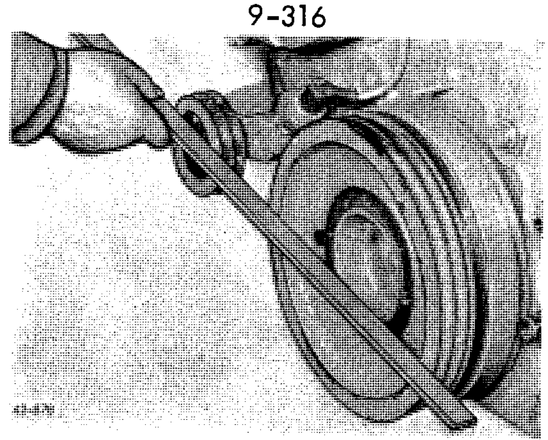
9-315

105. Insert breather with sealing compound and fsten to crankcase together with cable for warning switch.
Fig. 9-316

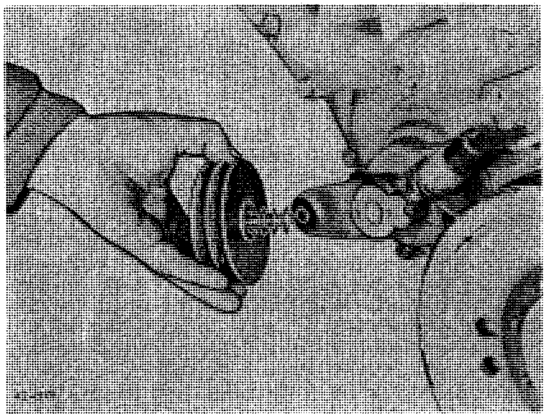


9-316

106. Check alignment of V-belt tensioning pulley with V-belt pulley on crankshaft.
Fig. 9-317

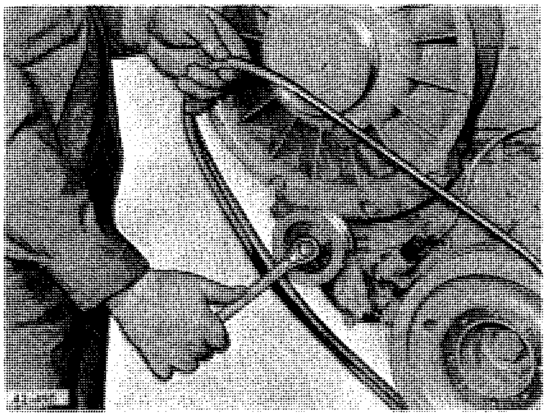


9-317



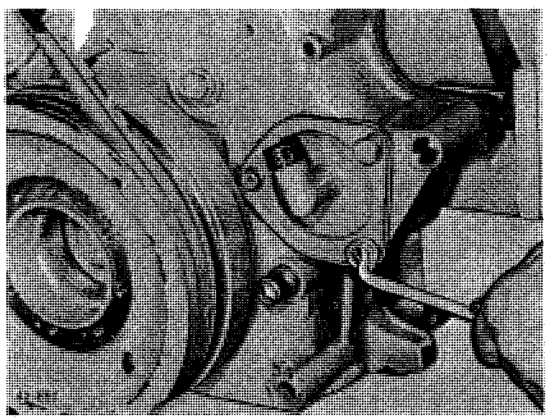
9-318

107. Correct any misalignment with compensating washers.
Fig. 9-318



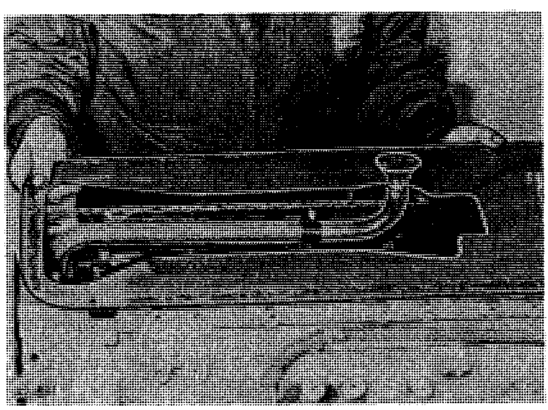
9-319

108. Place on V-belts.
Fig. 9-319



9-320

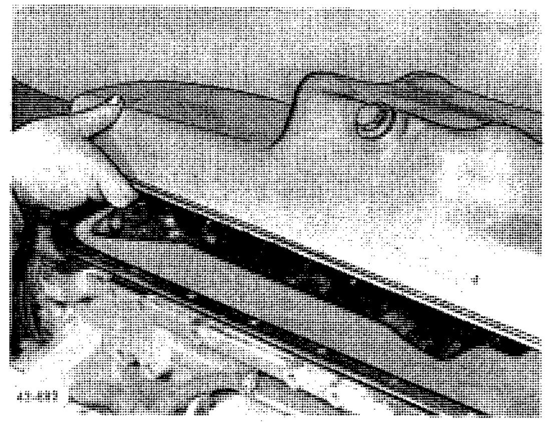
109. Mount cover.
Fig. 9-320



9-321

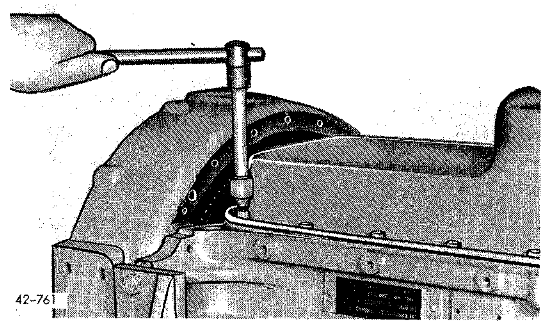
110. Affix gasket on crankcase with grease and place on intermediate plate correctly aligned.
Fig. 9-321

111. Affix gasket on intermediate plate with grease and place on oil pan correctly aligned.
Fig. 9-322



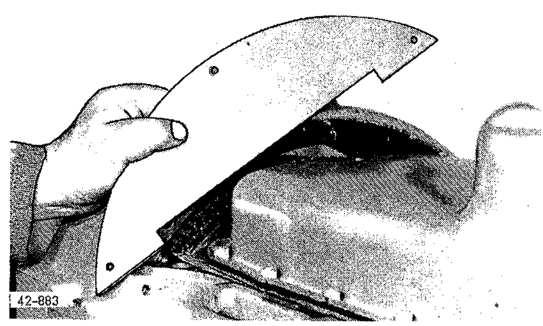
9-322

112. Insert bolts for oil pan and tighten up.
Fig. 9-323



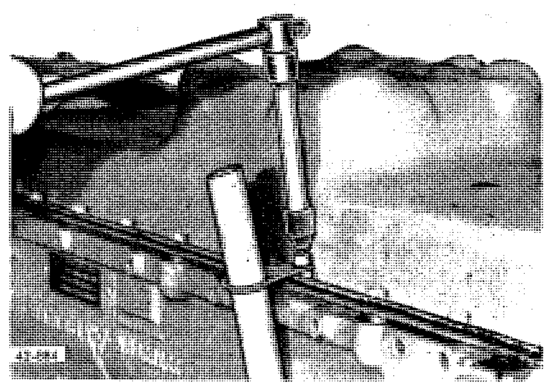
9-323

113. Mount cover plate.
Fig. 9-324

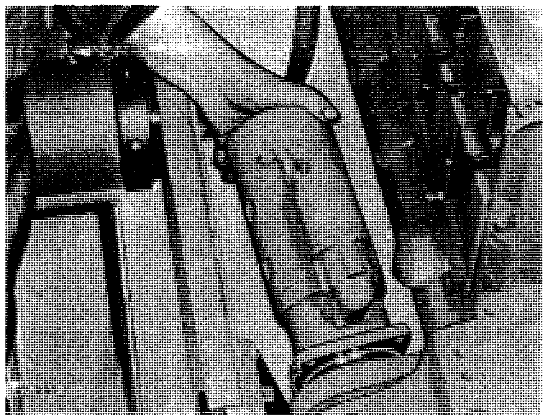


9-324

114. Mount retainer for breather hose.
Fig. 9-325

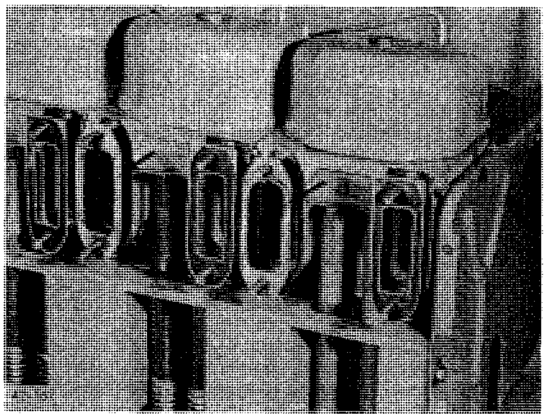


9-325



9-326

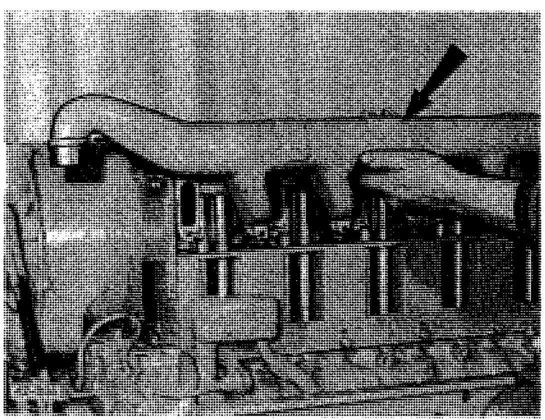
115. Mount starter motor.
Fig. 9-326



9-327

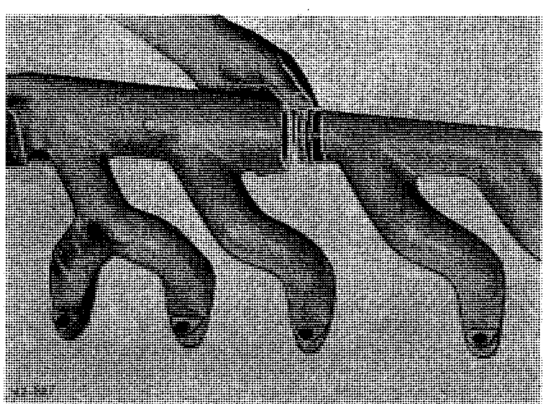
116. Mount gaskets for intake and exhaust manifolds, flattened ends at top.

Note:
Install gaskets for exhaust manifold with knurled side away from the cylinder head.
Fig. 9-327



9-328

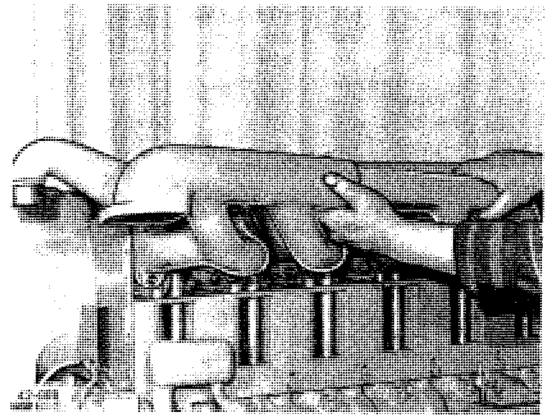
117. Check rubber sleeves for reuse. Mount intake manifold.
Fig. 9-328



9-329

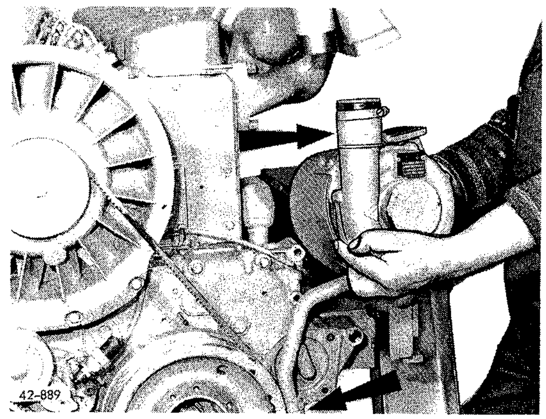
118. In case of divided exhaust manifold, relocate sealing rings.
Fig. 9-329

119. Mount exhaust manifold.
Fig. 9-330



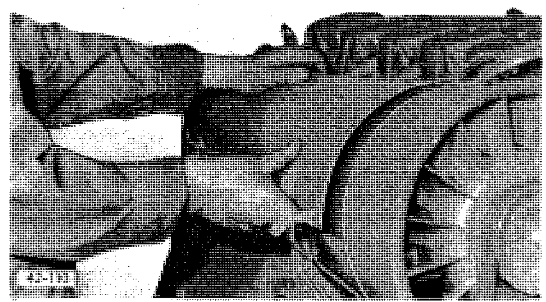
9-330

120. Check rubber sleeves for reuse. Mount turbocharger.
Fig. 9-331



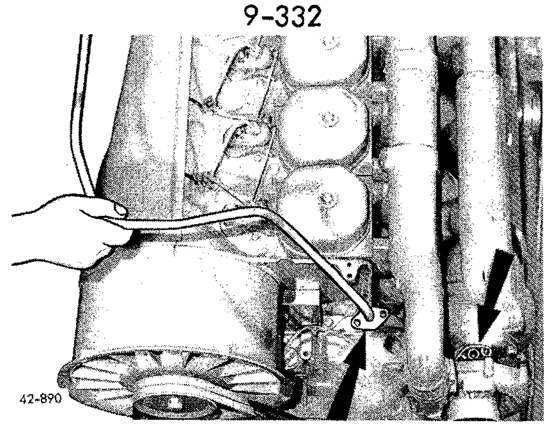
9-331

121. Mount air cowling.
Fig. 9-332

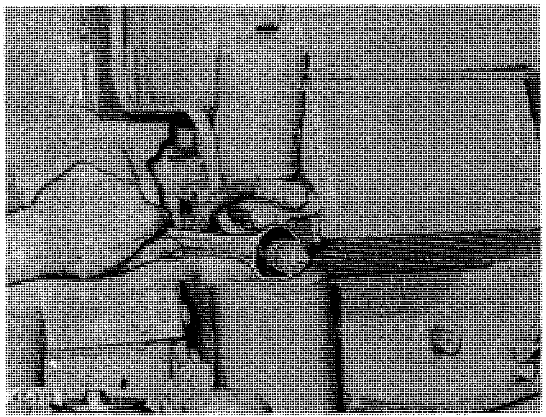


9-332

122. Mount lube oil line c/w new gasket at turbocharger -
Fig. 9-333

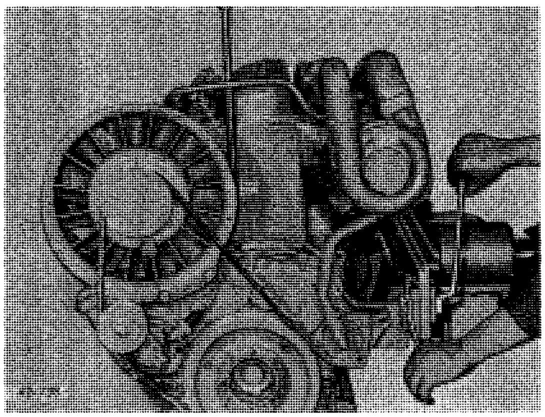


9-333



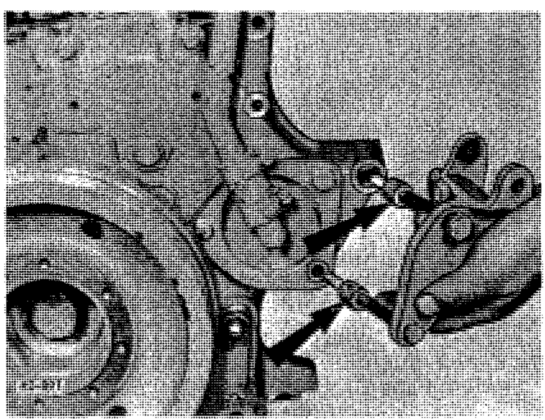
9-334

- and c/w new sealing rings at filter bracket.
Fig. 9-334



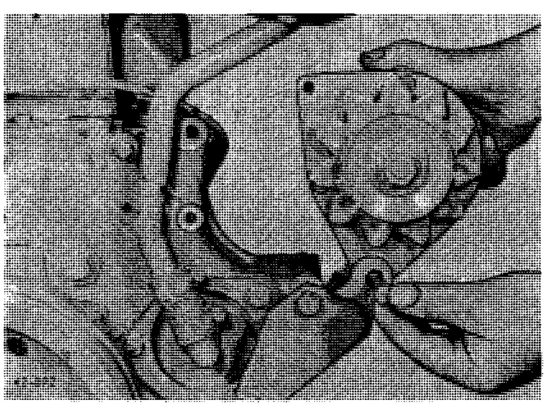
9-335

123. Remove engine from assembly stand.
Fig. 9-335



9-336

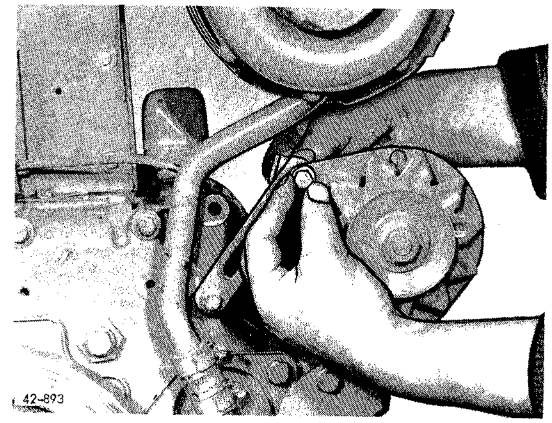
124. Mount retainer for alternator together with spacer bushes.
Fig. 9-336



9-337

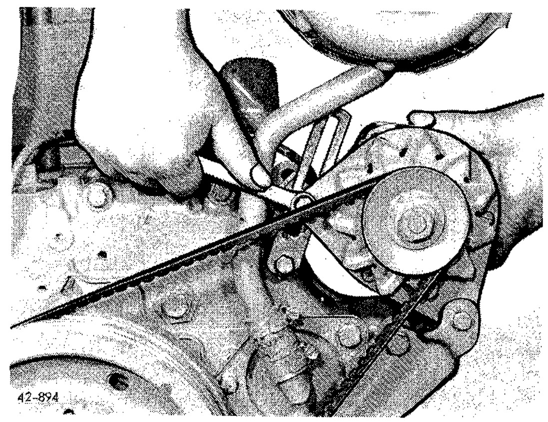
125. Fasten alternator to retainer.
Fig. 9-337

126. Fasten adjusting strap to front cover. Fasten alternator to adjusting strap.
Fig. 9-338



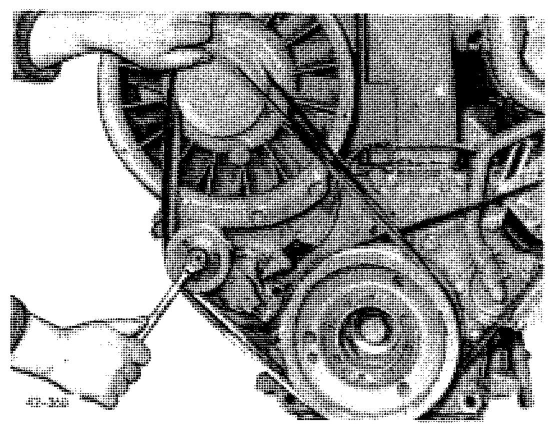
9-338

127. Place on V-belt. Tension V-belt by pulling the alternator round. Tighten up bolt on the adjusting strap.
Fig. 9-339

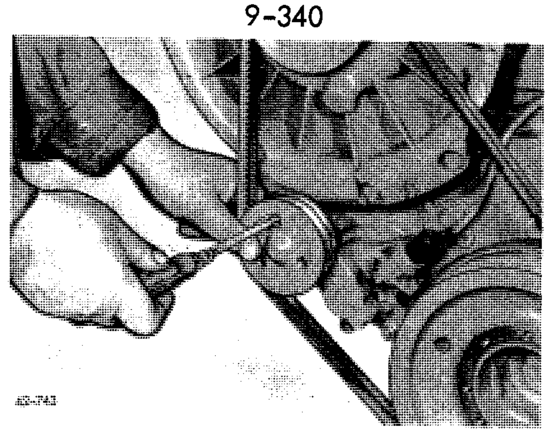


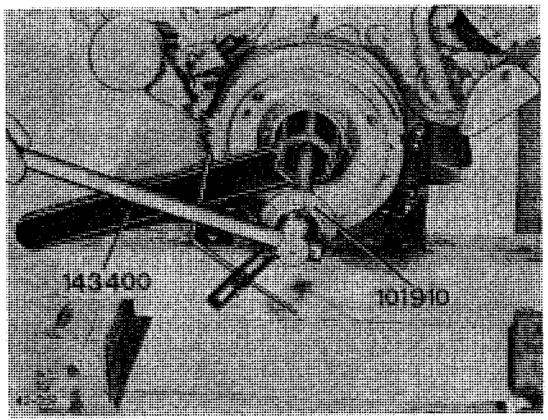
9-339

128. Pretension tensioning pulley. Place on V-belts for cooling blower.
Fig. 9-340

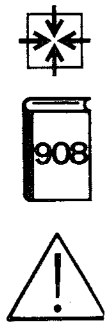

9-340

129. Screw on cover of tensioning pulley.
Fig. 9-341


9-341



9-342



130. Lock V-belt pulley with retainer. Tighten bolt as specified.

Note:

Bolt has left-hand thread!
Fig. 9-342

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10. Exhaust turbocharger

Page

Working Principle of Turbocharging

For improving the output, in-line engines are normally fitted with one turbocharger whereas V-engines are often fitted with two, one for each cylinder bank. The turbine rotor of the turbocharger is driven by the engine exhaust gases. The compressor impeller which is mounted on the same shaft takes in fresh air from outside and delivers it under pressure to the cylinders. By this method, the air volume entering the combustion chambers of turbocharged engines is increased as compared to naturally aspirated engines. Hence, the quantity of fuel injected increases and thus the output can be raised.

Since the temperature of the intake air goes up through being compressed by the compressor, charge air coolers may become necessary in order to bring down again the charge air temperature. By cooling down the charge air, the charge air density is increased as desired whilst the charge air pressure is kept reasonably low. Furthermore, where air-cooled charge air coolers are involved, the combustion air is cooled down to such an extent that the engine and the exhaust gas temperatures are not higher than those of naturally aspirated engines.

When the turbine rotor is driven by the kinetic energy of the exhaust gases emitted from the cylinders, this is called pulse charging. Where pulse charging is employed, only those cylinders which do not exhaust simultaneously are linked together by the exhaust pipe in order to allow for the pressure fluctuations to build up undisturbedly before the turbine. This in why engines with a large number of cylinders require separate exhaust pipings and a multi-flow turbine intake manifold.

The hot exhaust gas also heats up the bearings. Therefore, good lubrication and cooling of the bearings is essential, which is ensured by means of a lube oil piping connected to the lube oil circuit of the engine.

RECOMMENDATIONS FOR OPERATION AND MAINTENANCE

KKK Turbolader

Valid:	5900 008 2556	03.84 E
Replaced:	5900 008 2527	03.79 E

The Engine Manufacturer's recommendations for Operation and Maintenance shall be authoritative for the operation of Turbocharged Engines. Special attention should be paid to:

1. Operation Recommendations

- When the engine is started a full load should not be put on right away. We recommend that after the engine has been left to idle for a short time, it is then warmed up at medium speeds and with a medium load.
- After the engine has been operating at full load for a longer period of time, we recommend a short idling time before switching off, in order to avoid heat accumulating.

2. Maintenance Recommendations

- Turbochargers and boost pressure control valves do not require any maintenance.
- Engine oil has to be changed regularly in accordance with the Engine Manufacturer's Instructions.
- Maintenance work has to be carried out regularly on the oil filter and air filter systems, in accordance with the Engine Manufacturer's Instructions.
- Checks have to be made on the oil, air and exhaust piping, as well as, on all other connections and seals, to ensure that they are still tight and no damage has occurred.
- When carrying out maintenance work on the engine (e.g. adjusting valves), in most cases the piping leading from or to the turbocharger must be removed. Close the piping openings on the turbocharger. Before fitting, clean the piping carefully.
- When fitting the turbocharger to the engine, fill the bearing housing with clean oil and before fitting make absolutely sure that all piping connected to the turbocharger is cleaned carefully.

If this advice is followed a turbocharged engine has, from the experiences which we have had, the same lifespan as a naturally aspirated engine.

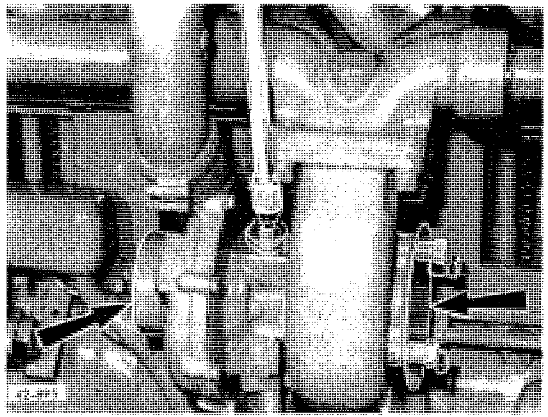
POSSIBLE DISTURBANCES IN TURBOCHARGED DIESEL ENGINES WITHOUT BOOST PRESSURE CONTROL VALVES

KKK Turbolader

Valid: 5900 008 2553 01.84 E
Replacing: 5900 900 0057 05.72 E

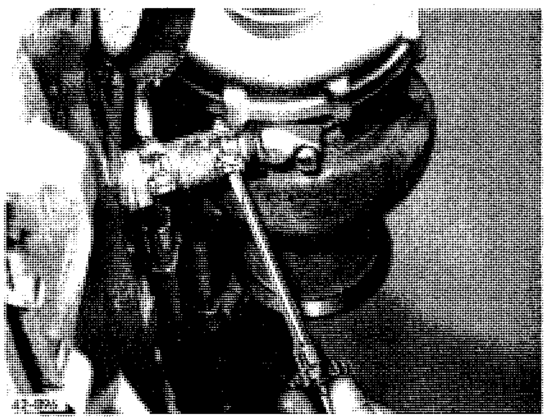
Type of disturbance	Possible cause	Remedy
1. Lack of power boost pressure too low	1.0 Air filter system dirty. Suction and pressure pipes deformed and/or leaking	Examine filter system, service or replace filter if required. Check and repair or replace pipes, tighten untight joints
	1.1 Too high flow resistance in the exhaust gas system and/or leakages upstream of turbine	Check exhaust brake, pipes, gaskets and silencers, carry out repairs required
	1.2 Injection unit and/or fuel system defective	Check setting values and function, correct if required
	1.3 Compression too low	Check valves, cylinders and pistons, service or replace defective parts if required
	1.4 Charge air cooler dirty	Clean unit and replace if necessary
	1.5 Turbocharger defective, wheels rubbing on housing walls	Examine turbocharger, repair or replace if necessary
2. Power and/or boost pressure too high	2.0 Injection unit defective	Check setting values and function and correct if required
3. Black exhaust smoke	See points 1.0, 1.3, 1.4, 1.5, 2.0	
4. Blue exhaust smoke	4.0 Worn valve guides and/or piston rings	Measure blow-by volume at crankcase outlet, overhaul engine if required
	4.1 Compressor-side and/or turbine-side sealing in the turbocharger defective	Examine turbocharger, repair or replace it as required
	4.2 Turbocharger oil drain pipe clogged and/or deformed	Clean oil drain pipe, repair if necessary
	4.3 See 1.0	
5. Oil leakage at turbocharger	5.0 Oil feed pipe and/or oil drain pipe loose and leaking	Clean turbocharger, check for leakages and rectify
	5.1 Leakage at connection between compressor and bearing housings	Repair or replace turbocharger

REMOVAL AND MOUNTING OF TURBOCHARGER



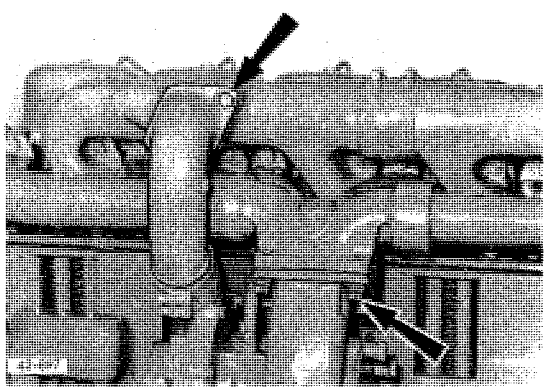
10-1

1. Blank off connections on compressor and turbine sides and remove lube oil line.
Fig. 10-1



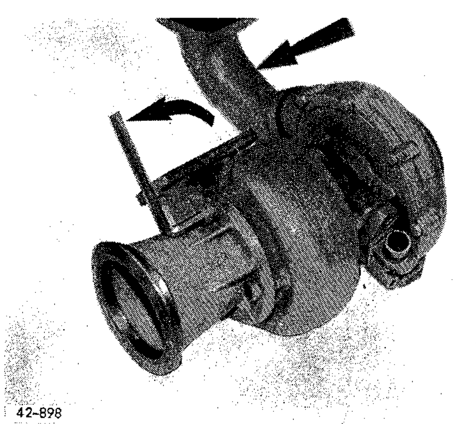
10-2

2. Remove oil return line.
Fig. 10-2



10-3

3. Screw off flanges and take off turbocharger.
Fig. 10-3



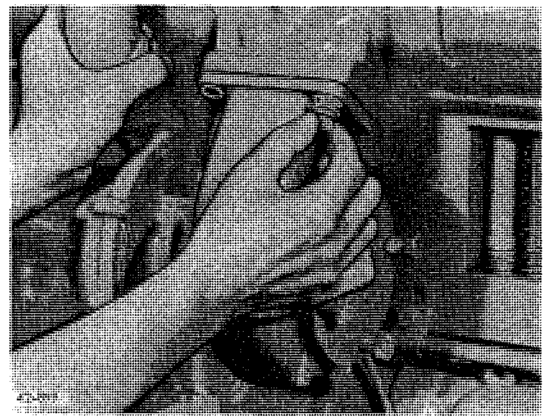
10-4

4. Mount connection branch (on turbine side) and pipe bend, arrow.
Fig. 10-4

5. Mount exhaust turbocharger, using new seals.
Fig. 10-5

Note:

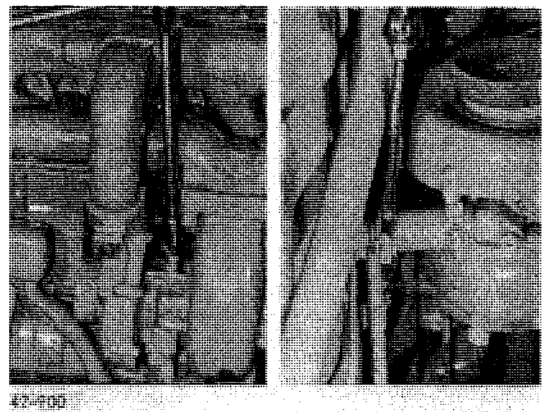
When mounting the turbocharger to the engine fill bearing housing with clean oil.
Prior to that clean lube oil line thoroughly.



10-5

6. Fit lube oil line with new seal.
Fig. 10-6, LH-side

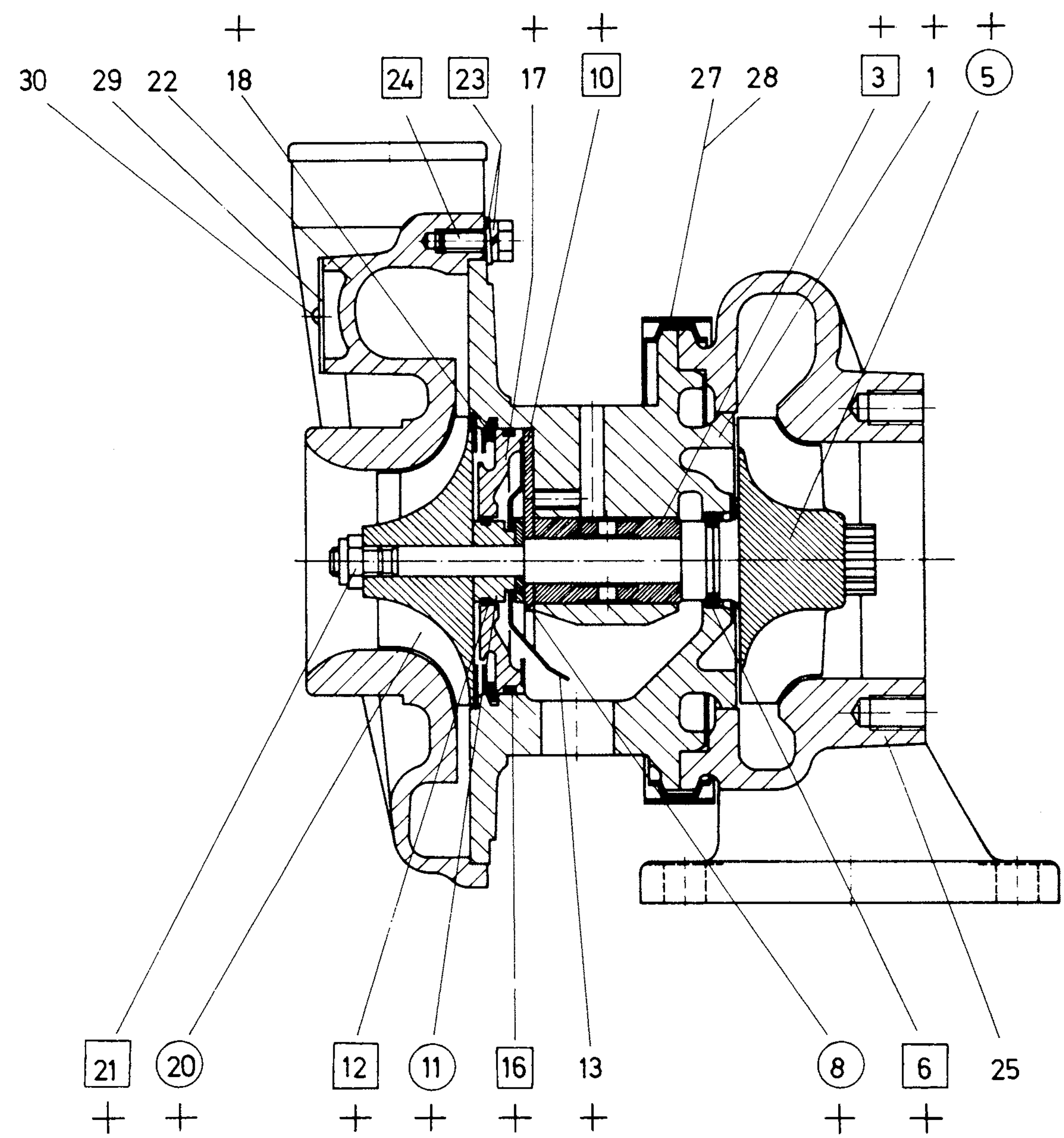
7. Fit oil return line with rubber sleeve and hose clips.
Fig. 10-6, RH-side



10-6

Aktiengesellschaft Kühnle, Kopp & Kausch D 6710 Frankenthal/Pfalz	Turbocharger 3LD	5222 011 30 03 Ausgabe: 4.81 ersetzt: Ausgabe 10.77

□ Overhaul Kit ○ Rotor Assy + Core assembly



KKK 01-03684/1 10.77

REPAIR GUIDELINES
Series 3LD, 3LDZ

KKK Turbolader

Gültig: 5900 008 25 43 10.86 D
Ersetzt: 5900 008 25 43 03.82

ALWAYS USE GENUINE KKK SPARES!

The numbers in brackets are the item nos. of the parts concerned.

I. DISMANTLING

1.1 - Mark positions of housings (22, 25) relative to bearing housing (1).

- Remove fastenings (24 and/or 27).

- Remove housing.

IMPORTANT:
Danger of blade damage when canted.

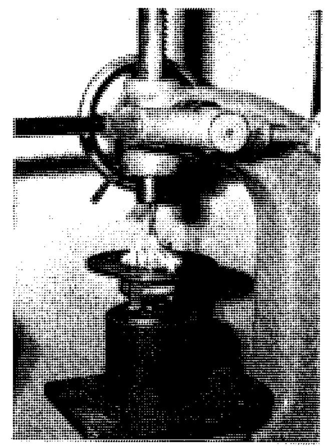
- Clamp rotor (5) at hub in special jaws (see Repair Tools) and remove shaft nut (21).
Fig. 1.1

1.1

- If shaft nut is jammed heat to a max. temp. of 130° C, using hot air blower. (Rotor thread must be protected against overheating.)

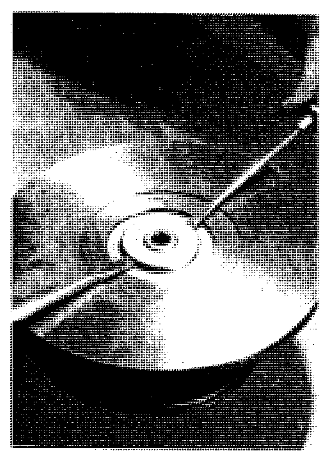
IMPORTANT:
When loosening shaft nut (21) take care that shaft is not subjected to bending stresses.

1.2 - Heat compressor impeller (20) to a max. temp. of 130° C, using hot air blower (see Repair Tools) (protect rotor thread against overheating) and carefully press out rotor (5), using a press (upright drill press).
Fig. 1.2



1.2

1.3 - Remove snap ring (18) and lift off bearing plate (17).
Fig. 1.3



1.3

- Press sealig bush (11) out of bearing plate (17); remove piston ring (12).

- Remove oil deflector (13), thrust ring (8) and thrust bearing (10).

- Lift off bearing housing (1) from rotor (5); remove piston rings(s) (6).

- Lift off bearing bush (3) from shaft.

2. CLEANING AND INSPECTING OF THE PARTS

2.1 Cleaning of the parts
- Thoroughly clean all parts:
housings (1, 22, 25), rotor (5), compressor impeller (20), bearing plate (17), heat shield (31) and clamping strap (27) by wet sand blasting.
- Rotor thread: remove LOCTITE residue!

IMPORTANT:
Protect bearing bores and piston ring contact surface on bearing housing (1), shaft on rotor (5) and piston ring contact surface on bearing plate against the blasting medium.

2.2 Checking the parts

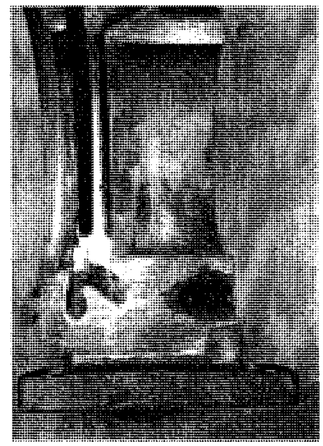
2.2.1 Visual check
- Check housings (1, 22, 25), heat shield (31) and impellers for cracks, foreign matter and chafing marks. Inspect oil supply bores in bearing housing (1) for foreign matter. Inspect piston ring contact surfaces and bearing points for damage.
- Check turbine housing (25) for scale and exhaust inlet and outlet flanges for flatness.
- Check impellers (5, 20) for bent or broken blades and rotor shaft for score marks at bearing points.

LIMITS FOR REUSE:
Wearing parts worn beyond wear limits (see permissible wear tolerances) and rotating parts featuring cracks must be replaced.

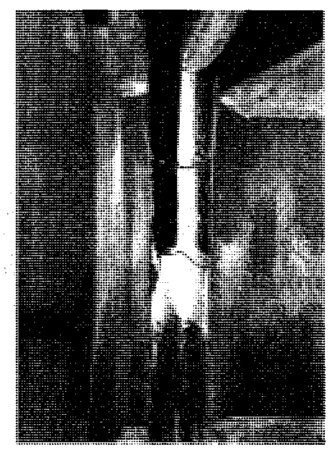
Turbine housing: Radial cracks up to 10 mm in the area of the tongue and the partition are permissible. Figs. 2.1 and 2.1.1
Slight chafing marks in the area of the contour are acceptable. In case of scale deposits on the web at exhaust inlet and on the contour, replace part.
Distorted exhaust inlet and outlet flanges must be replaced.
Rotor: Do not straighten bent blades. Rotors with bent blading must be replaced.
Rotors exhibiting chafing marks and cracks must be replaced.

2.2.2 Dimensional check
- Support rotor (5) at two bearing points in vee-blocks (see Repair Tools).
- Set dial gauge feeler onto shaft at about 5 mm from compressor impeller seating.
- During the check press shaft firmly onto blocks at constant pressure.
- If the true running deviation exceeds 0.008 mm, replace rotor. Fig. 2.2

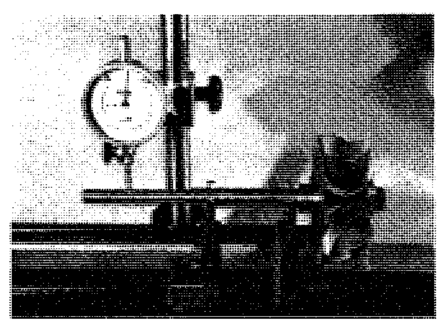
2.3 Dynamic balancing check of rotor assembly
- If the rotor assembly is to be reused, the assembly must be checked for proper balance. For this purpose, see the notes given in Service Information code no. 7/03/007.



2.1



2.1.1

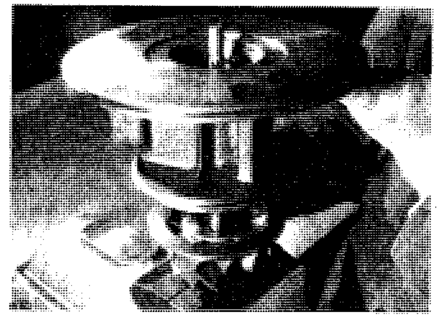


2.2

3. ASSEMBLY

UTMOST CLEANLINESS IS REQUIRED:
- Oil bearing parts and rotor shaft before fitting.

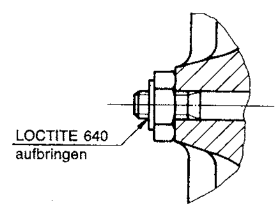
3.1 - Clamp rotor (5) in special jaws at hub (see Repair Tools), insert piston ring(s) (6) in groove privided.
- Slide bearing bush (3) onto rotor shaft.
- Guide bearing housing (1) carefully onto shaft. Fig. 3.1
- Take care that piston rings are aligned centrally. When using two piston rings the gaps must be offset by 180 degr.
- Insert thrust bearing (10), thrust ring (8) and oil deflector (13).


3.1

3.2 Before mounting the bearing plate (17):
- Insert sealing bush (11) with piston ring (12). Fig. 3.2
- Coat O-ring (16) with brake cylinder paste (e.g. ATE) and insert in groove provided in bearing plate.
- Fit snap ring (18).


3.2

3.3. - Heat compressor impeller (20) to a max. temp. of 130° C, using hot air blower or heating/drying oven.
- Oil compressor impeller seating on rotor (e.g. with Shell Ensis 20 W 20).
- Slide compressor impeller (20) onto rotor (5) and tighten shaft nut (21) to 10 Nm. When cooled down to room temperature apply LOCTITE 640 to compressor impeller (see sketch). Loosen shaft nut and tighten to 27 Nm.



Einbauskizze Wellenmutter

IMPORTANT:
Do not subject shaft to bending stresses when tightening shaft nut (21).

- Apply elastic sealing compound (LOCTITE 573) to compressor housing seating; mount housing 22).
- Seal shaft nut and threaded stem of rotor with locking compound.
- Gauge axial and radial clearances (see chapter Gauging of Bearing Clearances).

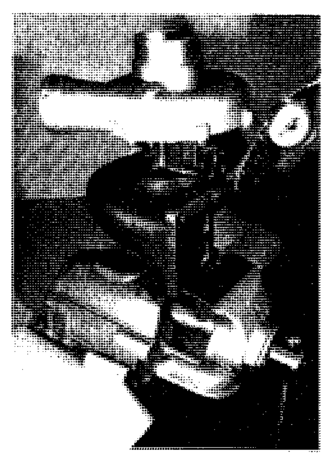
IMPORTANT:
Do not cant housing (22) when positioning.

- Tightening torque for bolts: 16 Nm.

3.4 - Mount turbine housing (25)

IMPORTANT:
Do not cant housig (25) when positioning.

- Fit clamping strap (27) with new hexagonal nut and torque to 14 Nm. Fig. 3.4


3.4

4. REPAIR TOOLS	For loosening fastening bolts on compressor housing
4.1 Standard tools - Box wrench - opening width 10, 7/16"	For loosening clamping strap nut
- 7/16" socket spanner	For loosening shaft nut
- Socket spanner with T-socket, opening width 13	For tightening shaft nut and fastening bolts
- Torque wrench, measuring range 0-60 Nm sockets, opening widths 10, 13, 17, 7/16", with 3/8" square drive hole	For fitting and removing snap rings for bearing plate
- Snap ring pliers KKK Part No. 54554088 J 31	Auxiliary tools
- Screwdriver, hammer, rubber mallet, protective caps for vise	For gauging end float and radial clearance
- Dial gauge, 0.01 mm division DIN 878, A1	For checking true running of rotor
- Precision dial gauge, 0.001 mm division DIN 879, B1-20	For loosening clamping strap
4.2 Special tools - Clamping strap pliers KKK Part No. 15 50 073	For removing and refitting of compressor impeller
- Hot air blower e.g. Leister make: Leister hot air tool Type "Ghibli 2" Part No. 08 L 130	For clamping rotor at stub for performing repair work
- Vise jaws, Drwg. No. 155 0013	For checking rotor for true running
- Gauge, Drwg. No. 158 2036	For supporting the core assy. in case of seized compressor impeller
- Supporting tube dia. 102, L = 160	In connection with supporting tube for removal of rotor in case of seized compressor impeller
- Auxiliary mandrel, dia. 7.7, L = 35	

DETERMINING THE BEARING CLEARANCES
Series 3LD, 3LDZ

Turbolader

Gültig: 5900 008 25 43 10.86 D
Ersetzt: 5900 008 25 46 03.83

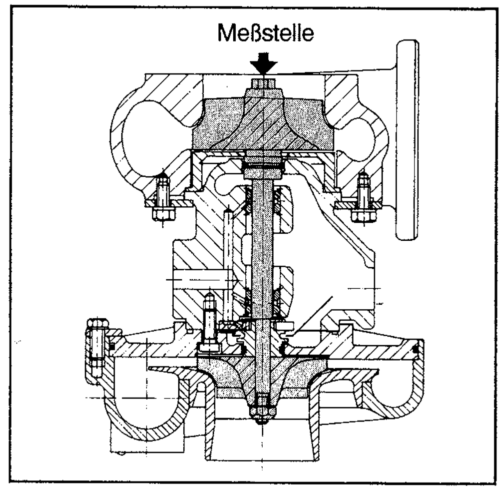
1. Gauging axial clearance (end float)

- Place contact point of dial gauge in position at turbine rotor hub center.
Fig. 1.1

- Press rotor down and set dial gauge to zero.

- Press rotor against dial gauge and record deflection of pointer.

- Permissile axial clearance: 0.25 mm



1.1

2. Gauging radial clearance

- Radial clearance is to be determined at turbine end only.

- Place contact point of dial gauge in position on cone of turbine rotor hub.
Fig. 2.1, 2.2

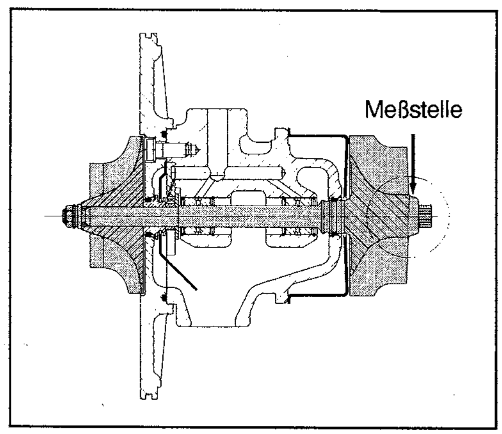
- Pull down turbine rotor hub, using a spring balance. Spring force: 50 N
Set dial gauge to zero!

Pull up turbine rotor hub, using spring balance. Spring force: 50 N.

- Record deflection of pointer.

- Repeat this measuring procedure with rotor turned by 90°.

- Permissible radial clearance: 0.60 mm



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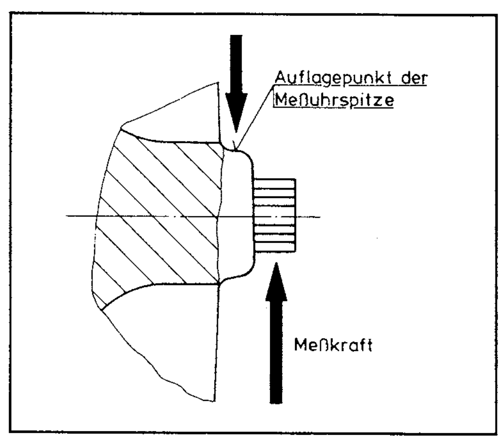


2.2

Gauge point

Contact point of dial gauge

Spring force

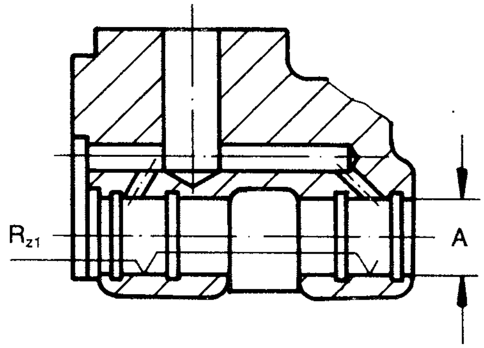
PERMISSIBLE WEAR LIMITS
Model 3LD, 3LDZ

Turbolader

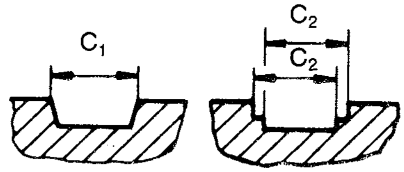
Gültig: 5900 008 25 43 10.86 D
Ersetzt: 5900 008 25 49 03.82

Use new piston rings and bearing bushes in any case

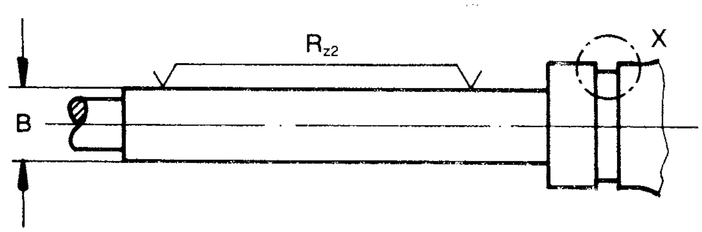
Bearing housing



Rotor
Detail X

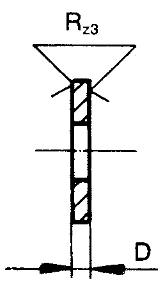


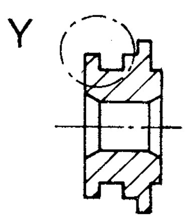
Wear of piston ring groove



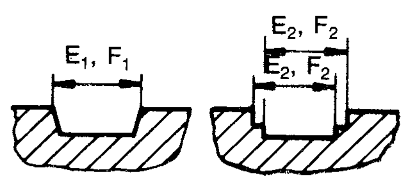
Sealing bush

Thrust ring



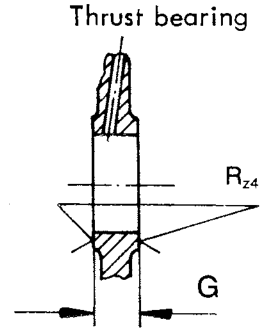


Detail Y



Wear of piston ring groove

Thrust bearing



Dimensions in mm
Dimensions in µm

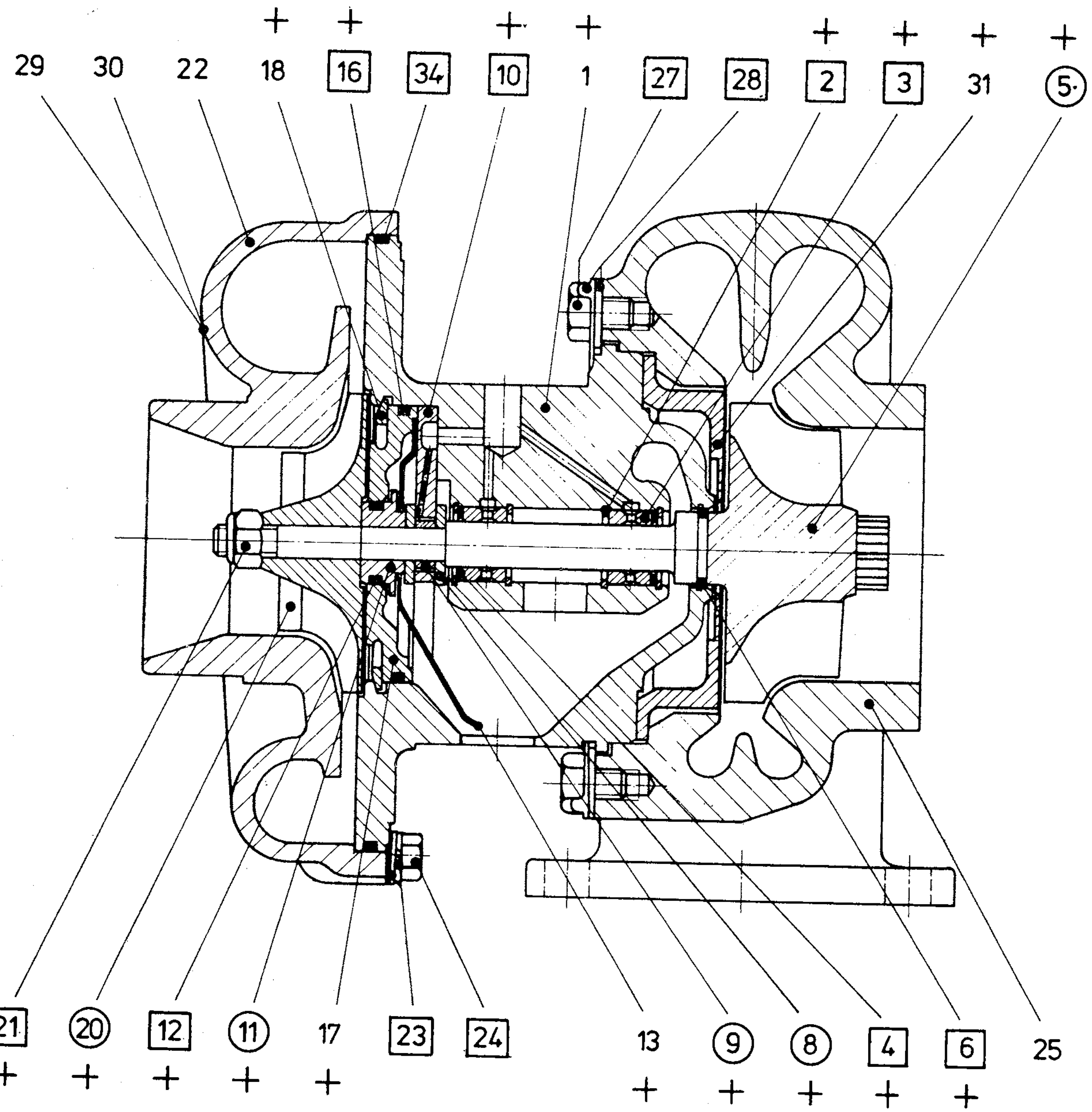
Model	A	B	C_1	C_2	D	E_1	E_2	F_1	F_2	G	R_{z1}	R_{z2}	R_{z3}	R_{z4}	
3LD, 3LDZ	22,27	12,193	3,32	3,37	2,23	1,72	1,77	3,32	3,37	2,69	4	1,6	4	8	

Aktiengesellschaft Kühnle, Kopp & Kausch D 6710 Frankenthal/Pfalz	Turbocharger	3LEP	5223 011 3008 Ausgabe: 4.81 ersetzt: 2.77

□ Overhaul Kit

○ Rotor Assy

\+ Core assembly



KKK 01-04231 02/77

REPAIR GUIDELINES
Series 3LE, 3LK, E, 4LB, 4LE, 4LF, 4LG, 4LGZ, 4MF, 3LEP

KKK Turbolader

Gültig: 5900 008 25 10 10.86 D
Ersetzt: 5900 008 25 10 05.73

ALWAYS USE GENUINE KKK SPARES!

The numbers in brackets are the item nos. of the parts concerned.

I. DISMANTLING

1.1 - Mark positions of housings (22, 25) relative to bearing housing (1).

- Remove housing fastenings (24 and/or 27).

- Remove housing.

IMPORTANT:
Danger of blade damage when canted.

- Clamp rotor (5) at hub in special jaws (see Repair Tools).

- Remove shaft nut (21), using T-spanner.
Fig. 1.1

- If shaft nut is jammed heat to a max. temp. of 130° C, using hot air blower. (Protect rotor thread against overheating.)

IMPORTANT:
When loosening shaft nut (21) take care that shaft is not subjected to bending stresses.

1.2 - Heat compressor impeller (20) to a max. temp. of 130° C, using hot air blower (see Repair Tools) (protect rotor thread against overheating) and carefully press out rotor (5), using a press (upright drill press).
Fig. 1.2

1.3 - Remove snap ring (18) and lift off bearing plate (17).
Fig. 1.3

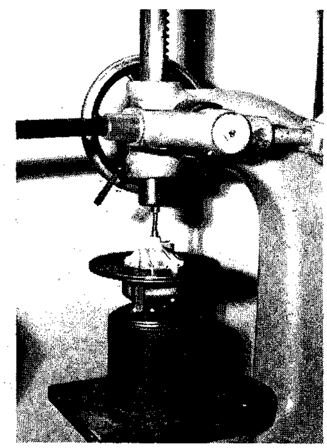
- Press sealing bush (11) out of bearing plate (17); remove piston ring (12).

- Remove oil deflector (13), thrust ring (8), thrust bearing, (10) spacer sleeve (9) and thrust ring (8).

1.4 - Lift off bearing housing (1) from rotor (5), remove piston ring (6) and bearing elements (3) at compressor and turbine ends from bearing housing.

1.5 - Remove supporting ring (31) from bearing housing (1) - does not apply to all models.

1.1



1.2

1.3

2. CLEANING AND INSPECTING OF THE PARTS

2.1 Cleaning of the parts

- Thoroughly clean all parts:
housings (1, 22, 25), guide ring (35), rotor (5), compressor impeller (20), bearing plate (17), heat shield (31) and clamping strap (27) by wet sand blasting.
- Rotor thread: remove LOCTITE residue!

IMPORTANT:
Protect bearing bores and piston ring contact surface on bearing housing (1), shaft on rotor (5) and piston ring contact surface on bearing plate against the blasting medium.

2.1

2.2 Checking the parts

2.2.1 Visual check

- Check housings (1, 22, 25), heat shield (31) and impellers for cracks, foreign matter and chafing marks. Inspect oil supply bores in bearing housing (1) for foreign matter. Inspect piston ring contact surfaces and bearing points for damage.
- Check turbine housing (25) and guide ring (35) for scale and cracks and exhaust inlet and outlet flanges for flatness.
- Check impellers (5, 20) for bent or broken blades and rotor shaft for score marks at bearing points.

LIMITS FOR REUSE:
Wearing parts worn beyond wear limits (see permissible wear tolerances) and rotating parts featuring cracks must be replaced.

Turbine housing: Radial cracks up to 10 mm in the area of the tongue and the partition are permissible.
Figs. 2.1 and 2.1.1
Slight chafing marks in the area of the contour are acceptable. In case of scale deposits on the web at exhaust inlet and on the contour, replace part.
Distorted exhaust inlet and outlet flanges must be replaced.
Rotor: Do not straighten bent blades. Rotors with bent blading must be replaced.
Rotors exhibiting chafing marks and cracks must be replaced.

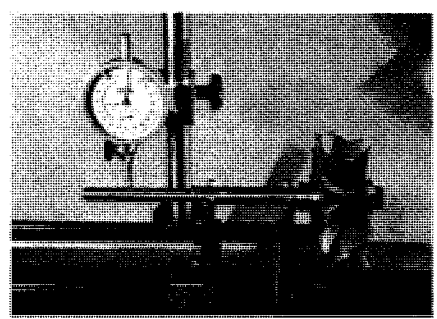
2.1.1

2.2.2 Dimensional check

- Support rotor (5) at two bearing points in vee-blocks (see Repair Tools).
- Set dial gauge feeler onto shaft at about 5 mm from compressor impeller seating.
- During the check press shaft firmly onto blocks at constant pressure.
- If the true running deviation exceeds 0.008 mm, replace rotor.
Fig. 2.2

2.3 Dynamic balancing check of rotor assembly

- If the rotor assembly is to be reused, the assembly must be checked for proper balance. For this purpose, see the notes given in Service Information code no. 7/03/007.



2.2

REPAIR GUIDELINES
Series 3LE, 3LK, E, 4LB, 4LE, 4LF, 4LG, 4LGZ, 4MF, 3LEP

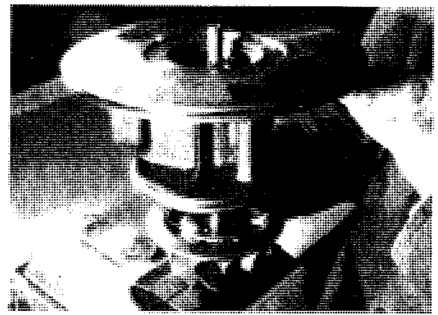
Turbolader

Gültig: 5900 008 25 10 10.86 D
Ersetzt: 5900 008 25 11 03.84

3. ASSEMBLY

- Utmost cleanliness is required.
- Oil bearing parts and rotor shaft before fitting. Fit bearing parts at turbine end (2, 3, 4) in bearing housing. Fit snap ring (2) at compressor end to fix the bearing.
- Models with supporting ring at turbine end: Place supporting ring (31) onto bearing housing (1).

3.1 - Clamp rotor at hub in special jaws (see Repair Tools), insert piston ring (6) in groove provided.
- Guide bearing housing (1) carefully onto shaft. Fig. 3.1
- Take care that piston ring is aligned centrally.
- Insert bearing element (3) and fit snap ring (2).
- Insert thrust ring (8), bush (9), thrust bearing (10), thrust ring (8) and oil deflector (13).



3.1

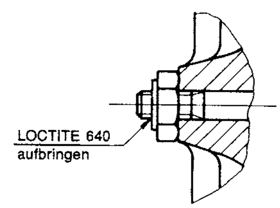
3.2 Before mounting the bearing plate (17):
- Introduce sealing bush (11) with piston rings (12).
- Piston rings must be installed with gaps offset by 180 degr. Fig. 3.2
- Fit O-ring (16) into groove provided on bearing plate.
- Fit snap ring (18).

3.2

3.3 - Heat compressor impeller (20) to a max. temp. of 130°C, using hot air blower or heating/drying oven.
- Oil compressor impeller seating on rotor (e.g. with Shell Ensis 20 W 20).
- Slide compressor impeller (20) onto rotor (5) and tighten shaft nut as follows:
Models E, 4LG: Tighten hot compressor impeller to 14 Nm. When impeller has cooled down to room temperature apply LOCTITE 640 (see sketch), loosen shaft nut and tighten to 27 Nm.

Model 4LB: Tighten hot compressor impeller to 14 Nm. When impeller has cooled down to room temperature tighten to 27 Nm.
Models 3LK, 3LE and 3LEP: Tighten hot compressor impeller to 9 Nm. When impeller has cooled down to room temperature tighten to 18 Nm.

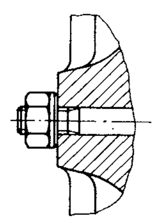
Models 4LE and 4LF: Tighten hot compressor impeller to 25 Nm. When impeller has cooled down to room temperature apply LOCTITE 640 (see sketch 4LE, 4LF), loosen shaft nut and tighten to 5 Nm and 60° - 5° tightening angle



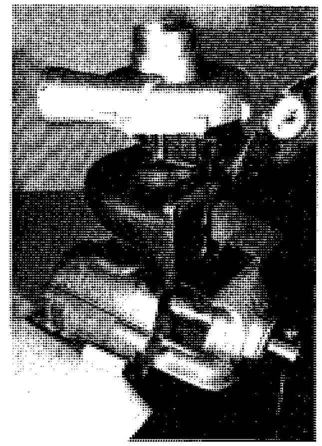
Einbauskizze Wellenmutter

Model 4MF: Set of spare parts 5252 711 00 00/01 (old), tighten hot compressor impeller to 21ÑNm. When impeller has cooled down to room temperature apply LOCTITE 640 (see sketch), loosen shaft nut and tighten to 42 Nm. Sets of spare parts 5252 711 00 02/03/04/05/07 tighten hot compressor impeller to 28 Nm. When impeller has cooled down to room temperature apply LOCTITE 640 (see sketch), loosen shaft nut and tighten to 56 Nm.

ATTENTION:
When tightening shaft nut (21) take care that shaft is not subjected to bending stresses.



Einbauskizze Wellenmutter
4LE, 4LF



3.4

- Seal shaft nut and threaded stem of rotor with locking compound.

- Gauge axial and radial clearances (see chapter Gauging of Bearing Clearances).

- Fit O-ring (34) in bearing housing groove, thus sealing the compressor housing.

- Mount compressor housing (22).

IMPORTANT
Do not cant housing (22) when positioning.

3.4 - Mount turbine housing (25) with guide ring (35) if provided.

ATTENTION:
Do not cant turbine housing (25) when positioning.

- Fit clamping strap with new hexagonal nut and torque to 14 Nm (4LB) or 10 Nm (E/4LE/4LG/4LGZ).

- Torque for screw connection at turbine end: 23 Nm (4MF), 20 Nm (3LK, 3LE, 3LEP)

- Torque for screw connection at compressor end: 6 Nm (3LK, 3LE, 3LEP)
Fig. 3.4

4. REPAIR TOOLS

4.1 Standard tools

- Box wrench - opening width 10, 13	For loosening fastening bolts on compressor housing
- 7/16" socket spanner 7/16" open end/box wrench	For loosening clamping strap nut
- Socket spanner with T-socket, opening width 13, 17	For loosening shaft nut
- Torque wrench, measuring range 0-60 Nm sockets, opening widths 10, 13, 17, 7/16", with 3/8" square drive hole	For tightening shaft nut and fastening bolts
- Snap ring pliers for 4LB, 4LG, 4MF KKK Part No. 1550 152 or 1550 153	For fitting and removing bearing bush snap rings
- Snap ring pliers KKK Part No. 54554088 J 31	For fitting and removing bearing plate snap rings
- Screwdriver, hammer, rubber mallet, protective caps for vise	Auxiliary tools
- Dial gauge, 0.01 mm division DIN 878, A1	For gauging end float and radial clearance
- Precision dial gauge, 0.001 mm division DIN 879, B1-20	For checking true running of rotor

4.2 Special tools

- Clamping strap pliers KKK Part No. 15 50 073	For loosening clamping strap
- Hot air blower e.g. Leister make: Leister hot air tool Type "Ghibli 2" Part No. 08 L 130	For removing and refitting of compressor impeller
- Vise jaws, Drwg. No. 155 0013	For clamping rotor at stub when performing repair work
- Gauge, Drwg. No. 158 2036	For checking rotor for true running
- Supporting tube 3LK, 3LE and 3 LEP, dia. 102, L = 160 4LE, 4LF, 4LG, 4LGZ, dia. 122, L = 160 4LB dia. 158, L = 160 4MF dia. 170, L = 160	For supporting the core assy. in case of seized compressor impeller
- Auxiliary mandrel, 3LK, 3LE and 3LEP dia. 7.7, L = 35 4LE, 4LF, 4LG, 4LGZ, 4LB dia. 10.9, L = 55 4MF dia. 12.5, L = 65	In connection with supporting tube for removal of rotor in case of seized compressor impeller

DETERMINING THE BEARING CLEARANCES
Series 3LE, 3LK, E, 4LB, 4LE, 4LF, 4LG, 4LGZ, 4MF, 3LEP

KKK Turbolader

Gültig: 5900 008 25 46 10.86 D
Ersetzt: 5900 008 25 46 03.83

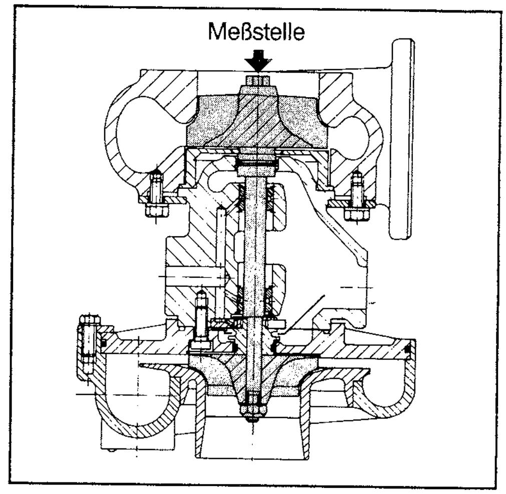
1. Gauging axial clearance (end float)

- Place contact point of dial gauge in position at turbine rotor hub center. Fig. 1.1

- Press rotor down and set dial gauge to zero.

- Press rotor against dial gauge and record deflection of pointer.

- The permissible axial clearance of models E, 3LE, 3LEP, 3LK, 4LB, 4LE, 4LF and 4MF is 0.15 mm and 0.20 mm for models 4LG, 4LGZ



1.1

2. Gauging radial clearance

- Radial clearance is to be determined at turbine end only.

- Place contact point of dial gauge in position on cone of turbine rotor hub. Fig. 2.1, 2.2

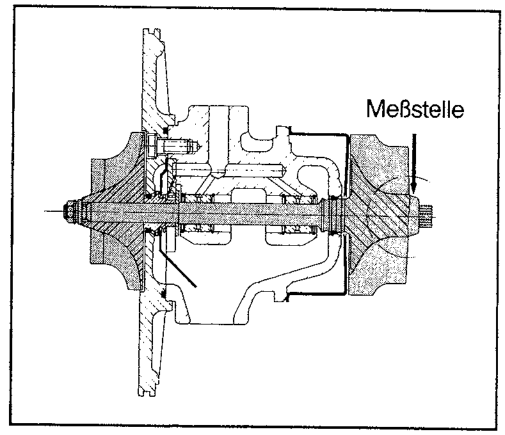
- Pull down turbine rotor hub, using a spring balance. Spring force: 50 N
Set dial gauge to zero!

Pull up turbine rotor hub, using spring balance. Spring force: 50 N.

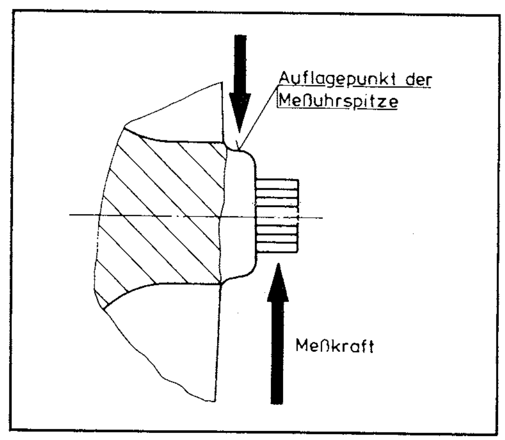
- Record deflection of pointer.

- Repeat this measuring procedure with rotor turned by 90°.

- The permissible radial clearance of models E, 3LE, 3LEP, 3LK, 4LB, 4LE, 4LG, 4LGZ and 4MF is 0.65 mm



2.1



2.2

Gauge point

Contact point of dial gauge

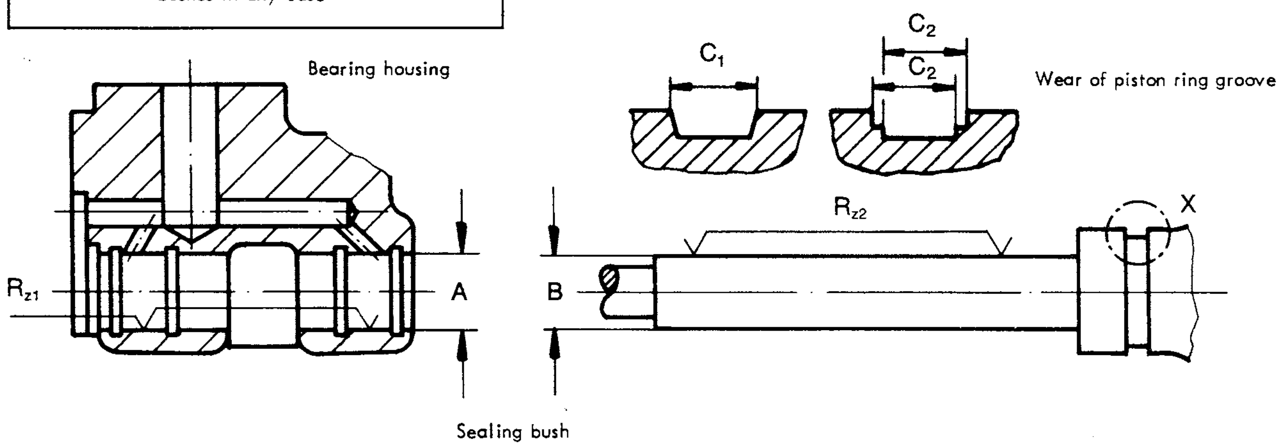
Spring force

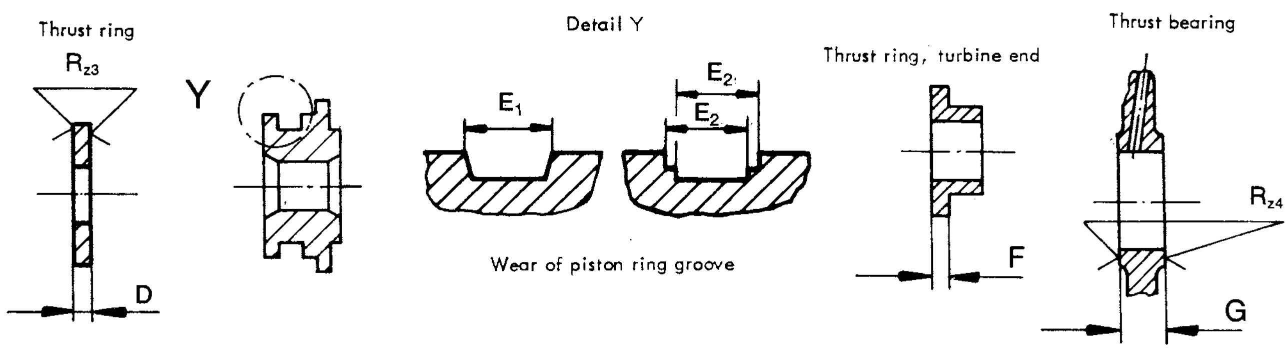
PERMISSIBLE WEAR LIMITS
Series 3LE, 3LK, E, 4LB, 4LE, 4LF, 4LG, 4LGZ, 4MF, 3LEP

KKK Turbolader

Gültig: 5900 008 25 10 10.86 D

Use new piston rings and bearing bushes in any case





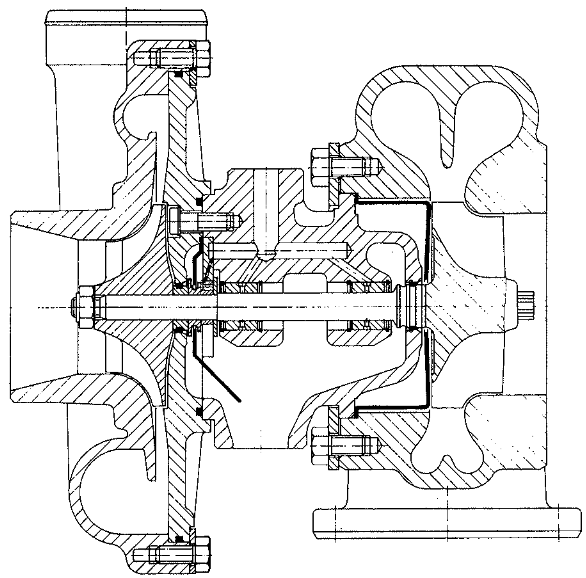
Dimensions in mm
Dimensions in µm

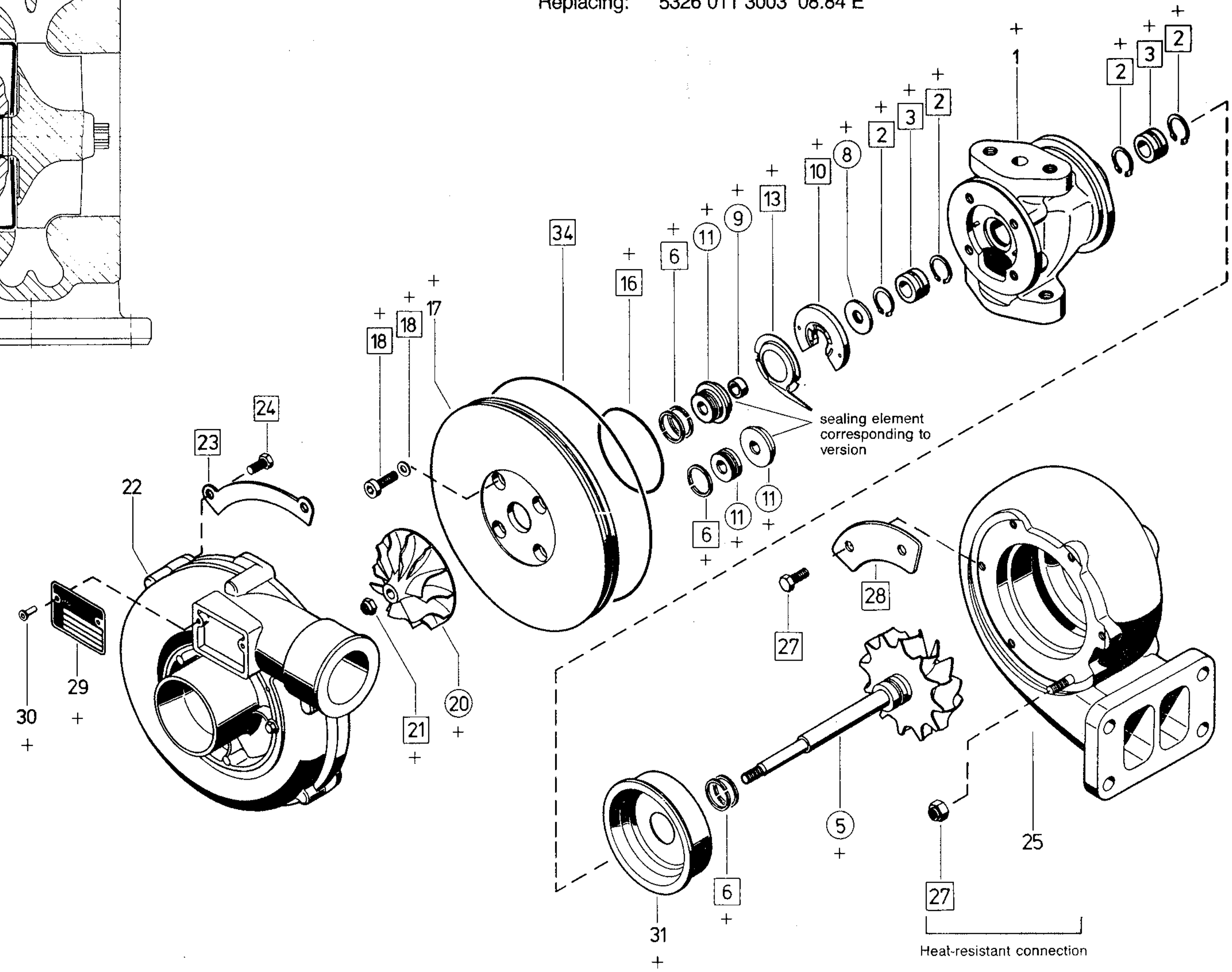
	A	B	C_1	C_2	D	E_1	E_2	F	G	R_{z1}	R_{z2}	R_{z3}	R_{z4}		
3LK, 3LE 3LEP	19,06	11,17	2,89	2,94	2,49	3,32	3,37	1,1	5,33	4	1,6	4	8		
E	22,30	14,255	1,72	1,77	2,49	3,32	3,37	1,17	5,33	4	1,6	4	8		
4LB	27,01	17,43	1,72	1,77	2,49	3,32	3,37	1,1	5,33	4	1,6	4	8		
4LG	27,01	17,43	1,72	1,77	2,49	3,32	3,37	1,1	5,33	4	1,6	4	8		
4LE, 4LF, 4LGZ	22,27	14,255	1,72	1,77	2,49	3,32	3,37	1,17	5,33	4	1,6	4	8		
4MF	27,01	17,43	3,32	3,37	2,49	3,32	3,37	1,1	5,33	4	1,6	4	8		

SERIES K2

Turbine housing twin-flow

Valid: 5326 011 3003 04.87 E
Replacing: 5326 011 3003 08.84 E





Pos.	Description of parts
1	Bearing housing
2	Snap ring
3	Bearing bush
5	Shaft & Turbine wheel assy.
6	Piston rings
8	Thrust ring
9	Spacer sleeve
10	Thrust bearing
11	Flinger sleeve oil deflector ring
13	Oil deflector
16	O-Ring
17	Backplate
18	Bolt, cyl. Washer
20	Compressor wheel
21	Shaft nut
22	Compressor housing
23	Clamp plate/compressor side
24	Bolt, hex.
25	Turbine housing
27	Bolt, hex. Nut, hex.
28	Clamp plate/turbine side
29	Nameplate
30	Blind rivet
31	Heat shield
34	O-Ring

□ **Overhaul kit**
\+ **Core assembly**
○ **Rotor assembly**

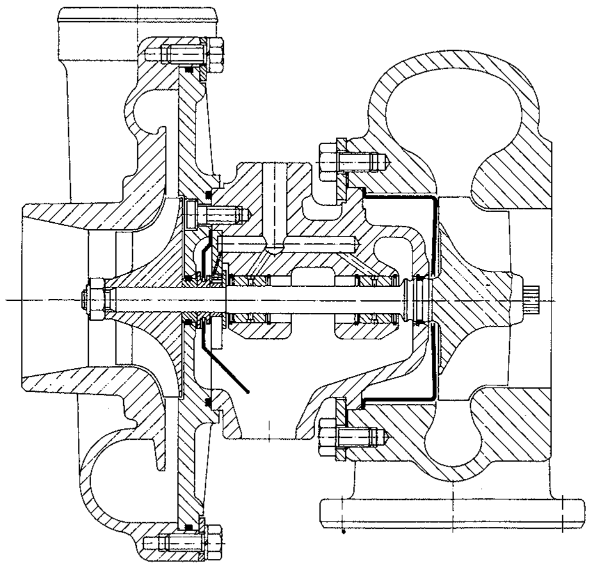
Aktiengesellschaft Kühnle, Kopp & Kausch D-6710 Frankenthal/Pfalz

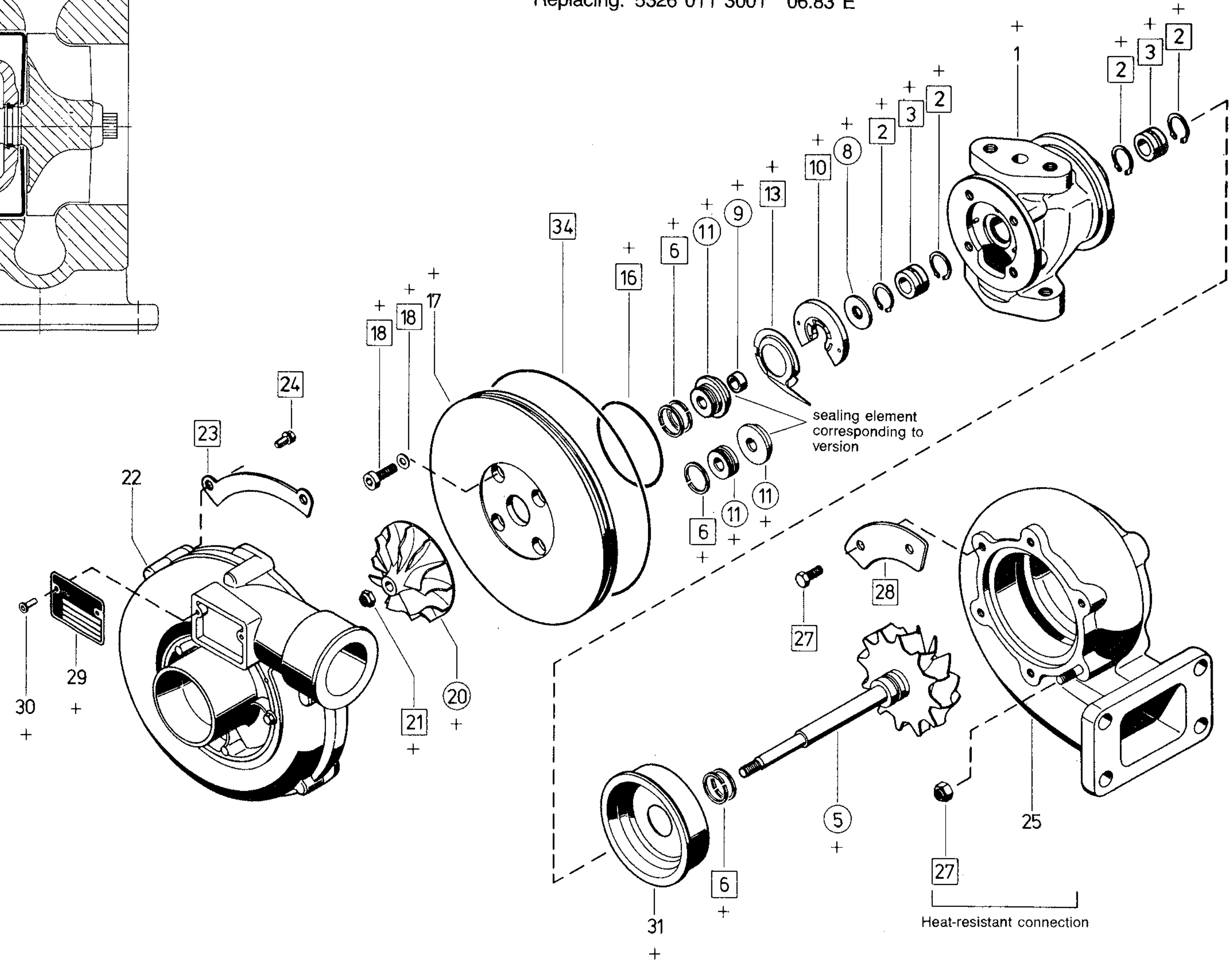
SERIES K2

Turbine housing single-flow

Turbolader

Valid:	5326 011 3001	08.84 E
Replacing:	5326 011 3001	06.83 E





Pos.	Description of parts
1	Bearing housing
2	Snap ring
3	Bearing bush
5	Shaft & Turbine wheel assy.
6	Piston rings
8	Thrust ring
9	Spacer sleeve
10	Thrust bearing
11	Flinger sleeve Oil deflector ring
13	Oil deflector
16	O-Ring
17	Backplate
18	Bolt, cyl. Washer
20	Compressor wheel
21	Locknut
22	Compressor housing
23	Clamp plate/compressor side
24	Bolt, hex. with lockwasher
25	Turbine housing
27	Bolt, hex. Nut, hex.
28	Clamp plate/turbine side
29	Nameplate
30	Blind rivet
31	Heat shield
34	O-Ring

□ **Overhaul kit**
\+ **Core assembly**
○ **Rotor assembly**

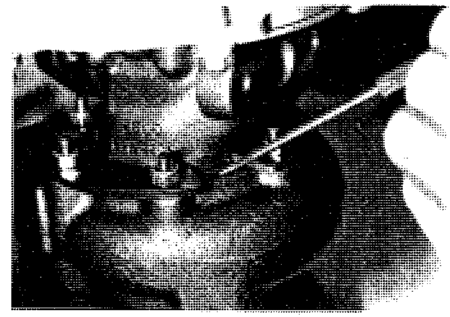
Aktiengesellschaft Kühnle, Kopp & Kausch D-6710 Frankenthal/Pfalz

The numbers in brackets are the item nos. of the parts concerned. (See: Turbocharger parts denomination and exploded view.)

I. DISMANTLING

I.I Turbine housing (25) and compressor housing (22).

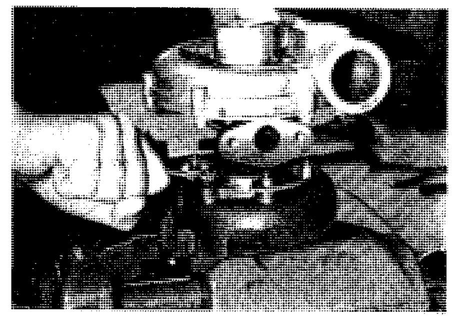
- Mark the position of the housings relative to bearing housing (I) and backplate (I7). Fig. I.I



1.1

- Clamp turbine housing (25) at gas inlet flange, using a vise. (Use vise jaw protective caps.)

- Remove fastenings (23, 24, 27, 28) from compressor housing (22) and turbine housing (25). Fig. I.2

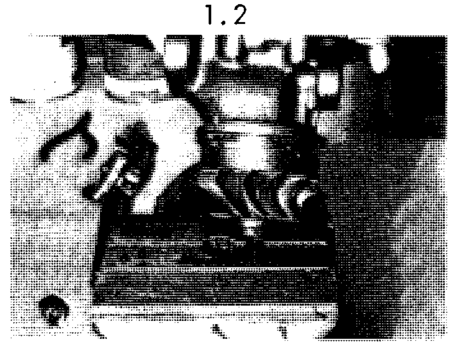


1.2

- Remove turbine housing (25) (when seized heat the area concerned).

- Remove compressor housing (22), if seized use rubber mallet.

Important:
Danger of blade damage when canted.

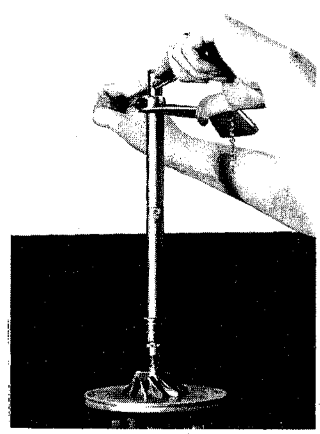


1.3

I.2 Compressor impeller (20)

- Clamp rotor (5) at hub in special jaws. (See Repair Tools). Fig. I.3

- Remove shaft nut (2I), using T-spanner. If shaft nut is jammed heat to a max. temp. of I30°C, using hot air blower. Rotor thread must be protected against overheating. Fig. I.4



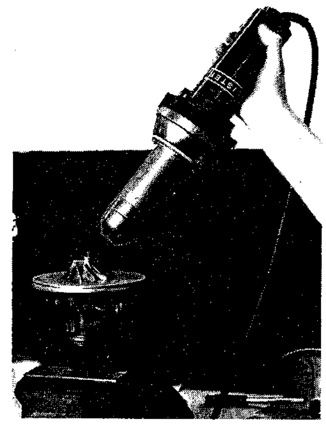
1.4

**Important:
Shaft nut (2I) is secured with LOCTITE 640. Take care that shaft is not subjected to bending stresses.**

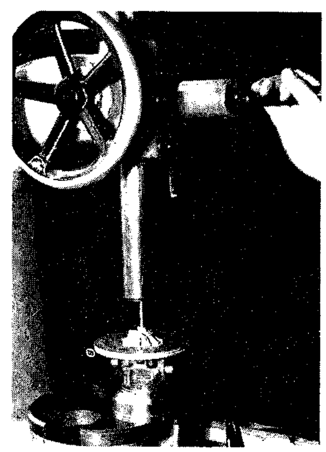
REPAIR GUIDELINES
Series K2

KKK Turbolader

Gültig: 5900 008 25 32 03.87 D
Ersetzt: 5900 008 25 32 06.84 D



1.5



1.5.1

- Heat compressor impeller (20) to a max. temp. of 130°C, using hot air blower (see Repair Tools) (protect rotor thread against overheating) and carefully press out rotor (5), using a press (upright drill press).
Figs. 1.5 - 1.5.1

Important:
Fit heat shield (31) centrally.

1.3 Bearing Housing (1)

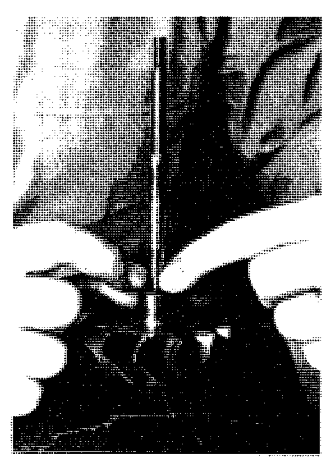
- Carefully remove rotor (5) from bearing housing (1).

- Remove piston rings (6) from rotor (5).
Fig. 1.6

- Remove heat shield (31).

- Clamp bearing housing (1) in vise between the oil feed and return flanges.

Note: Use vise jaw protective caps.



1.6

Remove fastening screws (18).
Fig. 1.7

Important:
Fastening screws (18) are secured with LOCTITE 640.

- Remove backplate (17) from bearing housing (1).

- Press sealing bush (11) out of backplate (17).

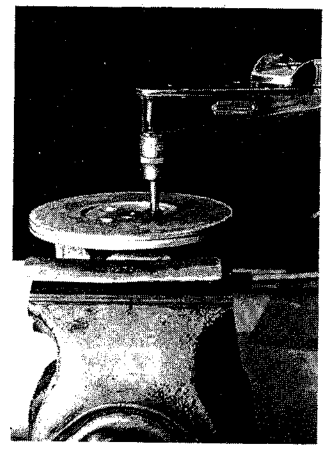
- Remove O-rings (16, 34) from backplate (17).

- Remove piston rings (6) from sealing bush (11).

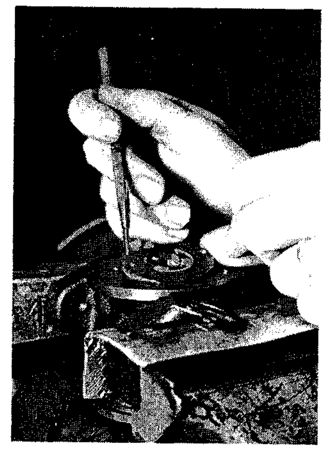
- Remove oil deflector ring (11), oil deflector (13) and thrust bearing (10) from bearing housing (1).
Fig. 1.8

- Remove spacer sleeve (9) and thrust ring (8) from bearing housing (1).
Fig. 1.9

- Remove snap rings (2) and bearing bushes (3). (For snap ring pliers see Repair Tools).
Figs. 1.10 - 1.11



1.7



1.8

1.11

1.10

1.9

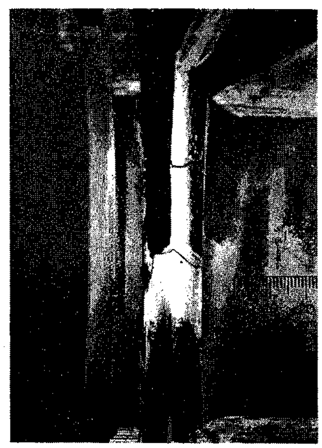
2. CLEANING AND INSPECTING OF THE PARTS
2.1 Cleaning of the parts
- Thoroughly clean all parts:
housings (1, 22, 25), rotor (5), compressor impeller (20), backplate (17) and heat shield (31) by wet sand blasting.

IMPORTANT:
Protect bearing bores and piston ring contact surface on bearing housing (1) and shaft and backplate (17) on rotor (5) against the blasting medium.

2.1

2.2 Checking the parts
2.2.1 Visual check
- Check housings (1, 22, 25), heat shield (31) and impellers for cracks, foreign matter and chafing marks. Inspect oil supply bores in bearing housing (1) for foreign matter. Inspect piston ring contact surfaces and bearing points for damage.
- Check turbine housing (25) for scale and cracks.
- Check gas inlet and outlet flanges for flatness.
- Check impellers (5, 20) for bent or broken blades and rotor shaft for score marks at bearing points.

LIMITS FOR REUSE:
Wearing parts worn beyond wear limits (see permissible wear tolerances) and rotating parts featuring cracks must be replaced.



2.1.1

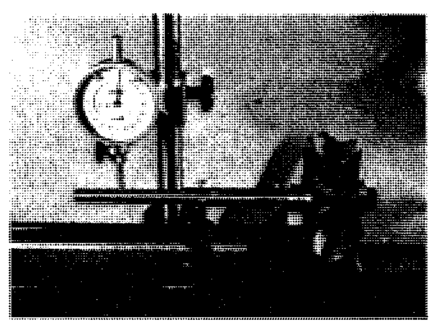
Turbine housing: Radial cracks up to 10 mm in the area of the tongue and the partition are permissible.
Figs. 2.1 and 2.1.1

Slight chafing marks in the area of the contour are acceptable. In case of scale deposits on the web at exhaust inlet and on the contour, replace part.
Distorted exhaust inlet and outlet flanges must be replaced.

Rotor: Do not straighten bent blades. Rotors with bent blading must be replaced.
Rotors exhibiting chafing marks and cracks must be replaced.

2.2.2 Dimensional check
- Support rotor (5) at two bearing points in vee-blocks (see Repair Tools).
- Set dial gauge feeler onto shaft at about 5 mm from compressor impeller seating.
- During the check press shaft firmly onto blocks at constant pressure.
- If the true running deviation exceeds 0.008 mm, replace rotor.
Fig. 2.2

2.3 Dynamic balancing check of rotor assembly
- If the rotor assembly is to be reused, the assembly must be checked for proper balance. For this purpose, see the notes given in Service Information code no. 7/03/007/d/e.



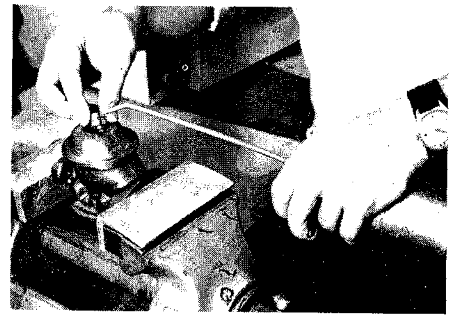
2.2

3. ASSEMBLY

- UTMOST CLEANLINESS IS REQUIRED.

- The following parts must be oiled before fitting:

- Rotor (5)
- Bearing bushes (3)
- Thrust bearing (10)
- Oil deflector ring (11)
- Oil deflector (13)
- Thrust ring (8)
- Piston rings (6)
- Spacer sleeve (9)

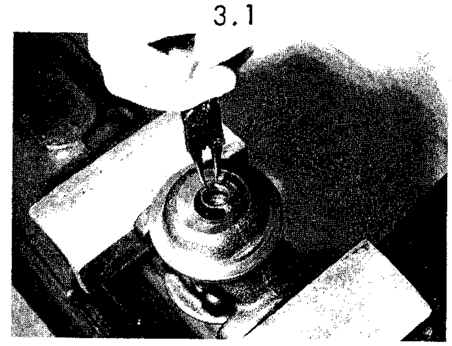


3.1

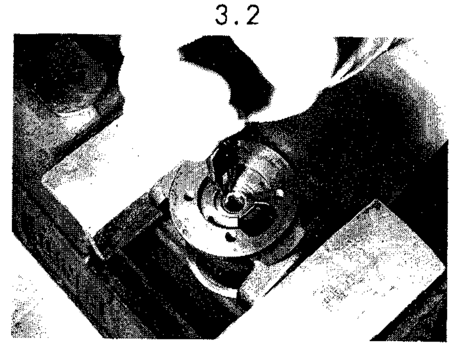
3.1 Bearing bushes (3)

- Fit bearing bushes (3) and snap rings (2) in bearing housing.
Figs. 3.1 - 3.3

Important:
When assembling bearing components utmost cleanliness is required.



3.2

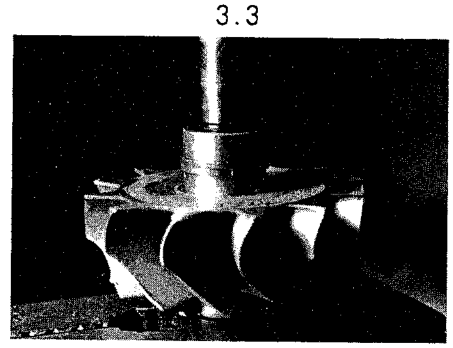


3.3

3.2 Bearing housing (1)

- Clamp rotor (5) in vise with hexagon/double hexagon jaws.

- Fit 2 piston rings (6) to rotor (5), making sure that they are installed centrally and that the piston ring gaps are offset by 180 degr.
Fig. 3.4



3.4

- Place heat shield (31) centrally on rotor (5).
Fig. 3.5

- Guide bearing housing (1) carefully onto rotor shaft.
Fig. 3.6

CHECK
piston rings (6) for proper seating. This is the case when heat shield (31) and bearing housing (1) turn freely.

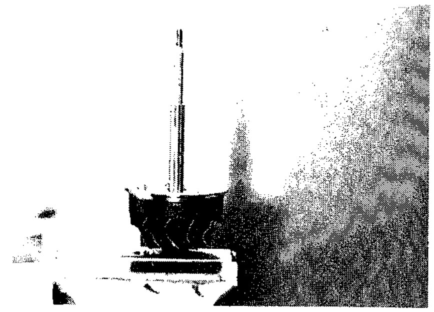
- Guide thrust ring (8) and spacer sleeve (9) onto rotor shaft.
Fig. 3.7

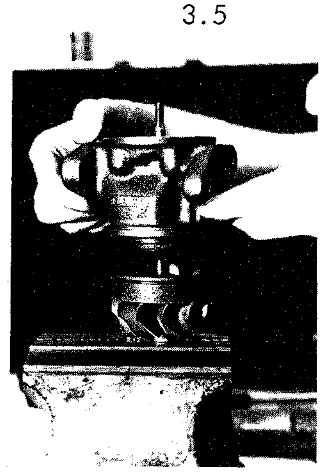
- Place thrust bearing (10) in bearing housing (1).
Fig. 3.8

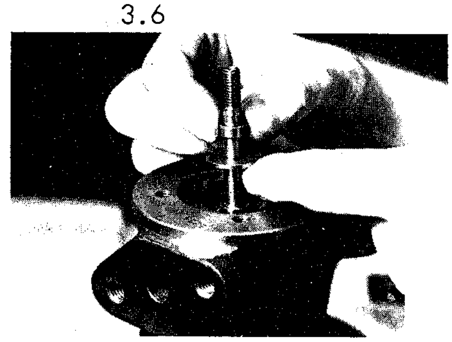
- Place a new oil deflector (13) on thrust bearing (10).
Fig. 3.9

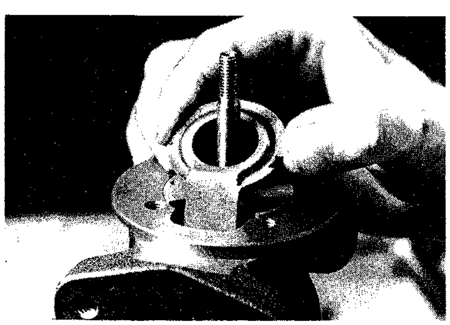
- Arrangement with oil deflector ring:
Guide oil deflector ring (11) onto rotor shaft with large collar facing upwards.

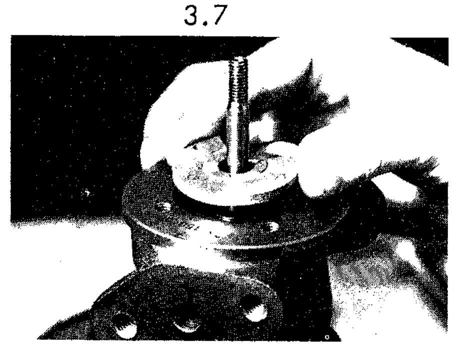
- Fit one/two piston rings (6) onto oil deflector ring (11). Piston ring gaps must be offset by 180 degr.


3.5


3.6


3.7


3.9


3.8

- Insert oil deflector ring (11), complete with piston rings (6) into backplate (17). If necessary compress piston rings together using screwdriver.
Fig. 3.10

- Sealing backplate (17) to bearing housing: Coat seating face of backplate (17) with LOCTITE 573.
Fig. 3.11

- For versions with O-seals, coat O-ring (16) with acid-free grease, e.g. SKF ball bearing grease, and place in groove provided.

- Place backplate (17) on bearing housing (1).

- Fasten backplate (17) to bearing housing (1) by means of cheese-head screws (18) and washers (18). The screws must be secured with LOCTITE 640.
Fig. 3.12

- For tightening torque see Data Sheet.

3.3 Compressor impeller (20)

- Heat compressor impeller (20) to a max. temp. of 130°C, using hot air blower (see Repair Tools) or heating/drying oven.

- Oil compressor impeller seating on rotor (e.g. with Shell Ensis 20W20).

- Push compressor impeller (20) onto shaft and tighten a new shaft nut (21) to tightening torque specified for hot condition.

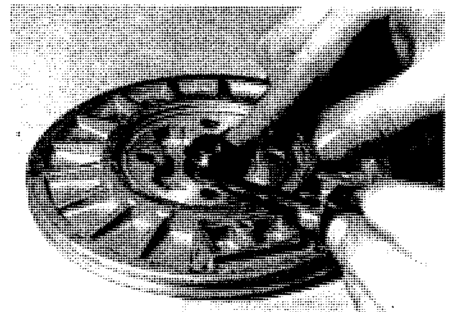
- When cooled down to room temperature apply LOCTITE 640 (see illustration). Loosen shaft nut (by 1 to 2 turns) and tighten to the specified torque and angle setting.
Fig. 3.13

- For tightening torques and angle settings see Data Sheet.

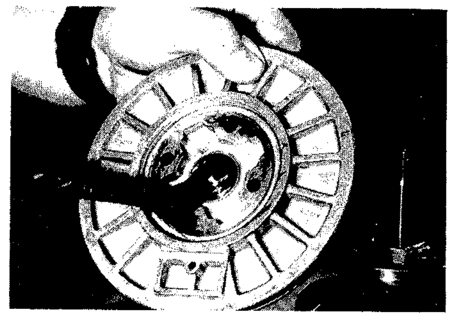
Important:
Do not subject shaft to bending stresses when tightening shaft nut (21).

- Seal shaft nut and threaded stem of rotor with locking compound.

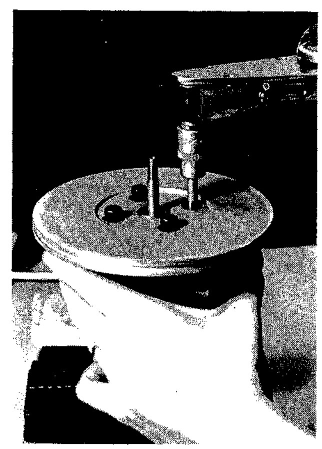
- Gauge axial and radial clearances (see chapter Gauging of Bearing Clearances).



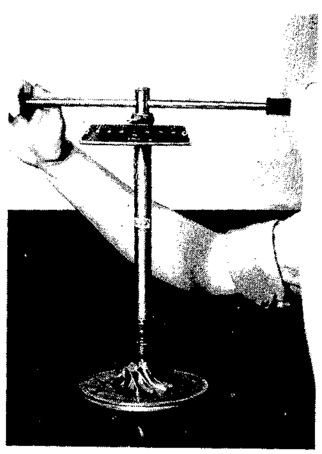
3.10



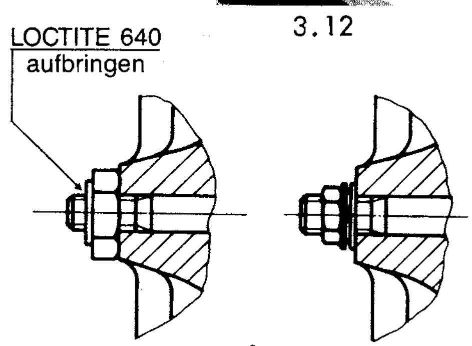
3.11



3.12



3.13

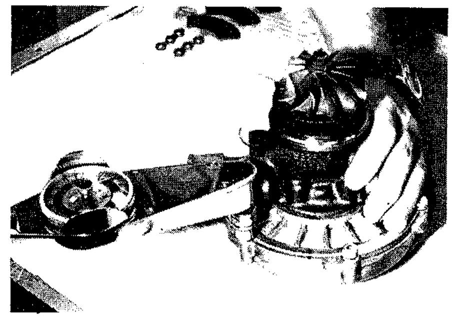


Einbauskizze Wellenmutter

3.4 Compressor housing (22)

- Spread O-ring (34) with brake cylinder paste, e.g. ATE, and position O-ring in groove provided on backplate.

- Mount compressor housing (22) to backplate (17) in position indicated, using the corresponding fastening elements (23, 24). Fig. 3.14



3.14

- For tightening torques see Technical Data.

IMPORTANT:
Do not cant housing (22) when positioning.

3.5 Turbine housing (25)

- Mount turbine housing in position indicated, using the corresponding fastening elements (27, 28).

IMPORTANT:
Do not cant housing (25) when positioning.

- Spread fastening bolts with heat-resistant lubrication paste, e.g. NEVER SEEZ.

- For tightening torque see Technical Data.

3.6 Nameplate (29)

- On turbochargers subjected to repairs replace blue nameplate (29) by red nameplate using blind rivet (30).

4. REPAIR TOOLS

4.1 Standard tools

- Box wrench - opening width 10, 13	For loosening fastening bolts on compressor and turbine housings
- 8" sliding T-handle with extension and sockets, opening widths 10, 12, 14	For loosening shaft nut
- Torque wrench, measuring range 0-60 Nm sockets, opening widths 10, 12, 14 with 3/8"	For tightening shaft nut and fastening bolts square drive hole
- Snap ring pliers KKK Part No. 1550 155, points 0.7 mm dia.	For fitting and removing snap rings for bearing bushes
- Screwdriver, hammer, rubber mallet, protective caps for vise	Auxiliary tools
- Dial gauge, 0.01 mm division DIN 878, A1	For gauging end float and radial clearance
- Precision dial gauge, 0.001 mm division DIN 879, B1-20	For checking true running of rotor

4.2 Special tools

- Hexagon socket (Ribe make) WN 22 000 Screwdriver insert for spline socket screws Ribe CV, Hommel make Hazet Part No. 8809-6 (M6)	For loosening and tightening backplate fastenings
- Inserting tool (open) for MANOSKOP torque wrench, opening widths 10, 13	For tightening fastening bolts at turbine end
- Hot air blower e.g. Leister make: Leister hot air tool Type "Ghibli 2" Part No. 08 L 130	For removing and refitting of compressor impeller
- Turning angle measuring instrument, 1/2" tang	For tightening shaft nut
- Vise jaws, Drwg. No. 155 0013	For clamping rotor at stub for performing repair work
- Gauge, Drwg. No. 158 2036	For checking rotor for true running
- Supporting tube	For supporting the core assy. in case of seized compressor impeller

K24/26: Inner dia. = 66 mm, length 100 mm
K27: Inner dia. = 84 mm, length 100 mm
K28: Inner dia. = 94 mm, length 100 mm

- Auxiliary mandrel, 6.8 mm dia.	In connection with supporting tube for removal of rotor in case of seized compressor impeller

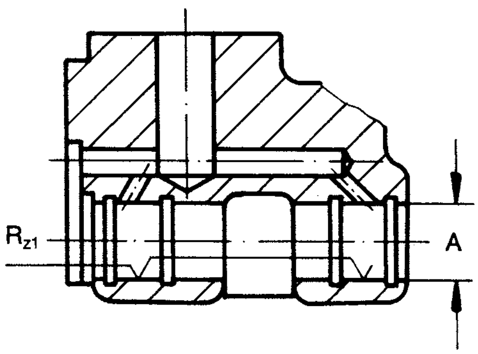
PERMISSIBLE WEAR LIMITS
Model K2

Turbolader KKK

Gültig: 5900 008 25 32 03.87 D
Ersetzt: 5900 008 25 38 06.84 D

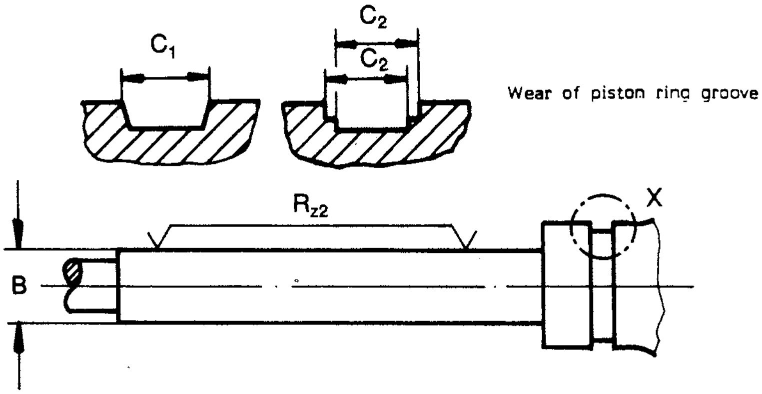
Use new piston rings and bushes in any case.

Bearing housing

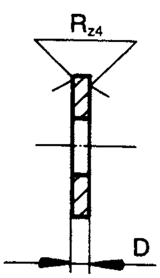


Rotor

Detail X

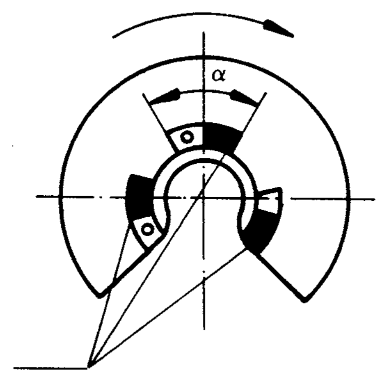


Thrust ring



Thrust plate

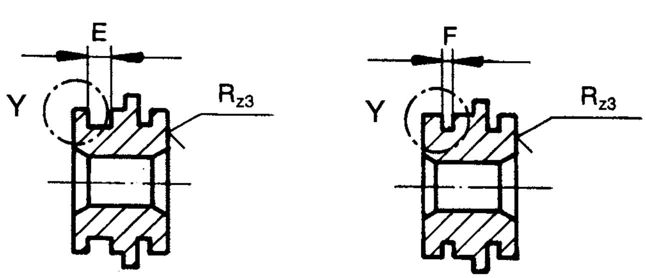
Direction of rotation



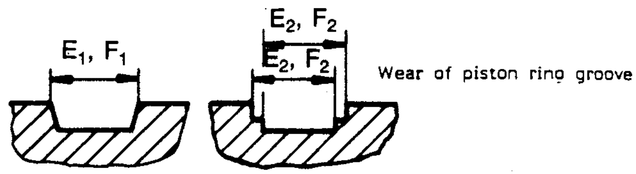
Sealing bush

2 Piston rings

1 Piston rings



Detail Y



Contact surfaces may show wear marks of up to $\frac{\alpha}{2} = 30°$

Dimensions A to K in mm R_{z1} to R_{z4} in microns

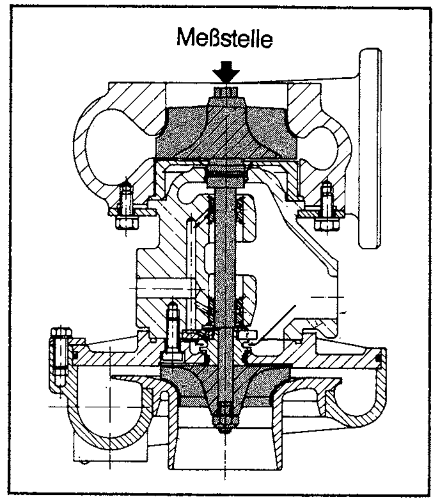
Model	A	B	C_1	C_2	D	E_1	E_2	F_1	F_2	R_{z1}	R_{z2}	R_{z3}	R_{z4}		
K2	16,064	9,95	2,89	2,94	1,47	2,89	2,94	1,49	1,54	4	1,6	4	4		

DETERMINING THE BEARING CLEARANCE
Model K

Turbolader

Gültig: 5900 008 25 35 03.87 D
Ersetzt: 5900 008 25 35 06.84 D

1. Gauging axial clearance (end float)
- Place contact point of dial gauge in position at turbine rotor hub center.
Fig. 1.1



1.1

- Press rotor down and set dial gauge to zero.

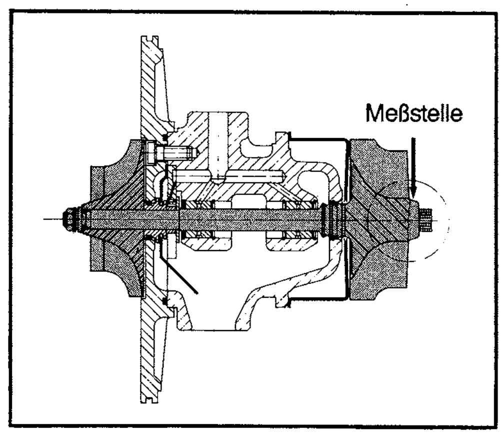
- Press rotor against dial gauge and record deflection of pointer.

- For permissible clearance see Technical Data.

2. Gauging radial clearance

- Radial clearance to be determined at turbine end only.

- Place contact point of dial gauge in position on cone of turbine rotor hub.
Fig. 2.1, 2.2



2.1

- Pull down turbine rotor hub, using a spring balance. Spring force: 50 N
Set dial gauge to zero!

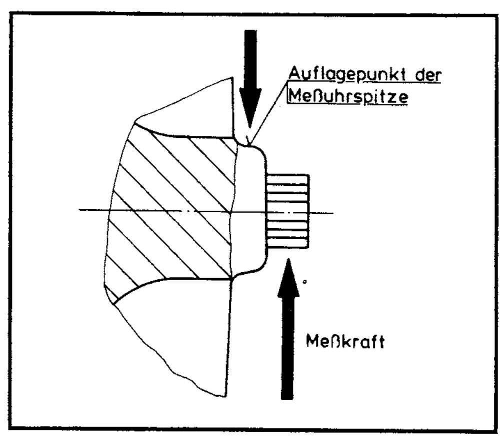
Pull up turbine rotor hub, using spring balance. Spring force: 50 N

- Record deflection of pointer.

- Repeat this measuring procedure with rotor turned by 90°.
- The permissible radial clearances are given in the Technical Data.

Gauge point

Contact point of dial gauge



2.2

Spring force

KKK Turbolader

DATA SHEET

SERIES K2

Valid: 5900 008 25 32 04.87 E
Cancelled: 5900 008 25 36 05.85 E

1. Tightening torques in Nm

part		size	K 24	K 26	K 27	K 28			
shaft nut	SW 10/12 mm self-locking M 6	tightening torque after preheating	5^{+2}						
shaft nut	SW 10/12 mm self-locking M 6	tightening torque	12^{+1}						
shaft nut	SW 10/12 mm M 6	tightening torque after preheating	7^{+2}			—			
shaft nut	SW 10/12 mm M 6	tightening torque + angle setting	$5_{+60°-5°}$			—			
shaft nut	SW 14 mm M 6	tightening torque after preheating	—	7^{+2}					
shaft nut	SW 14 mm M 6	tightening torque + angle setting	—	$5_{+60°-5°}$		10 $_{+60°-5°}$			
shaft nut	SW 10 mm M 5	tightening torque after preheating	5^{+2}	—	—	—			
shaft nut	SW 10 mm M 5	tightening torque	$6^{+0,5}$	—	—	—			
backplate fixing without washer			8	8	8	8			
backplate fixing with washer			10	10	10	10			
compressor housing			7	7	7	7			
turbine housing (M 6)			8	8	—	—			
turbine housing (M 8)			20	20	20	20			

2. Axial play in mm

size	K 24	K 26	K 27	K 28				
max. play	0,16	0,16	0,16	0,16				

3. Radial play in mm

size	K 24	K 26	K 27	K 28				
max. play	0,42	0,42	0,46	0,46				

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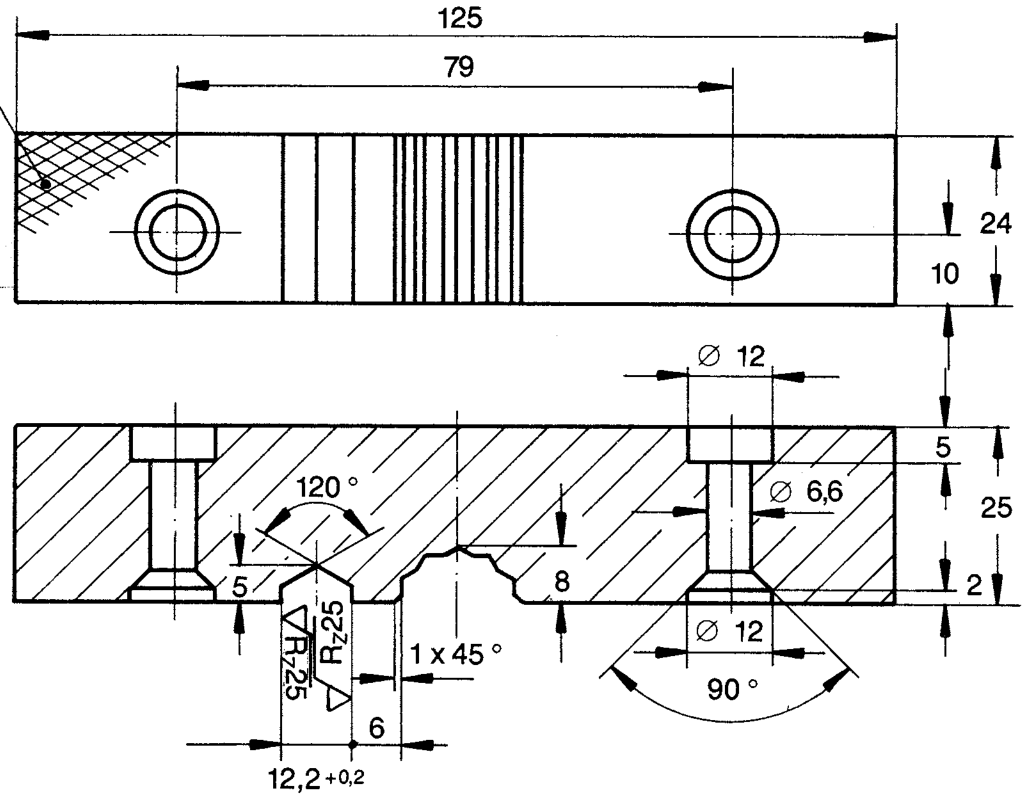
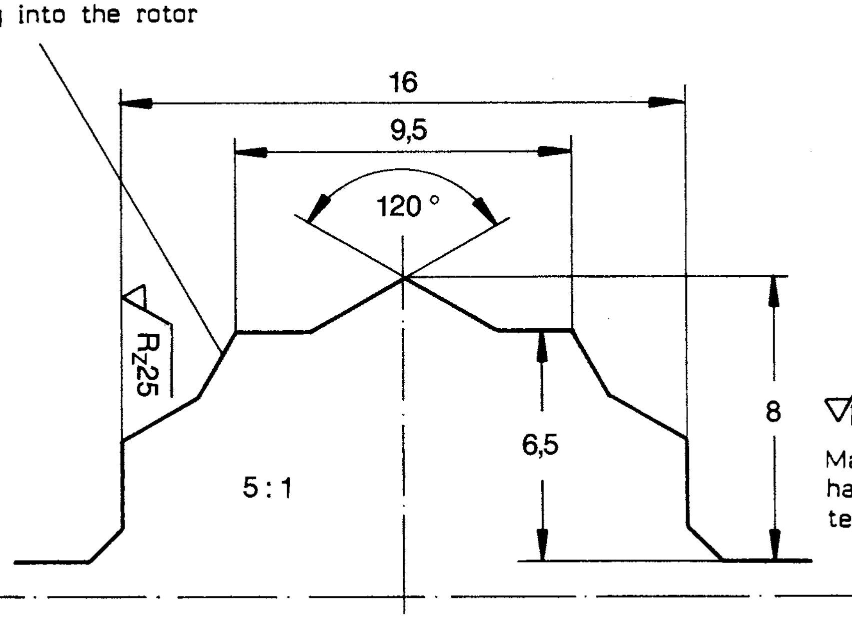
Gültig: 5900 008 25 32 01.84 D
Ersetzt: 5900 008 25 32 01.81 D

Vise jaws (1550013)





$\nabla R_z 63 (\nabla R_z 25)$

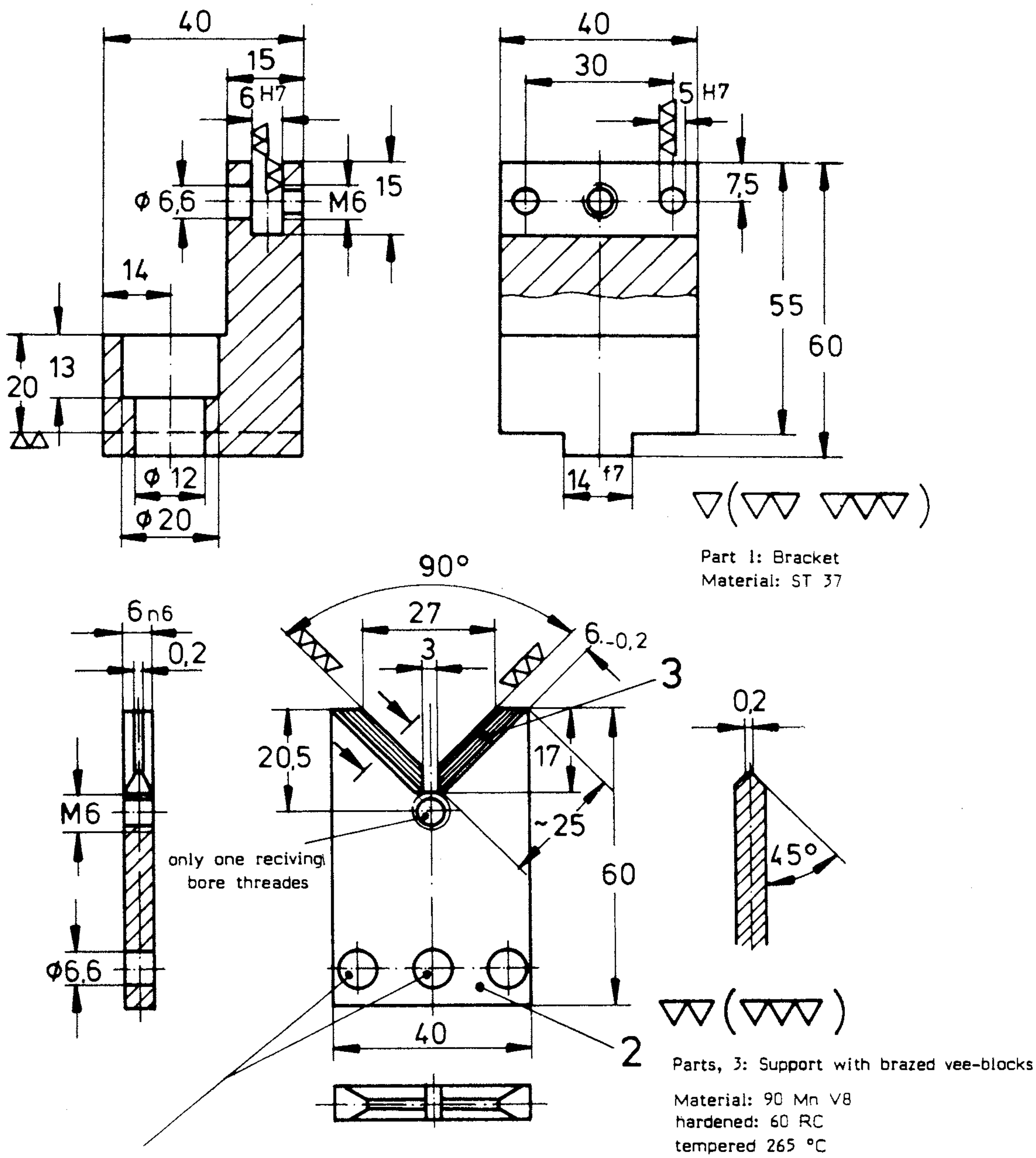
Material: C85W2
hardened: 65RC
tempered: 180°-300°C

SPECIAL TOOLS

Turbolader

Gültig: 5900 008 25 32 06.84 D
Ersetzt: 5900 008 25 32 01.81 D

Test Equipment for Checking Rotor
True Running



Part 1: Bracket
Material: ST 37

Parts, 3: Support with brazed vee-blocks

Material: 90 Mn V8
hardened: 60 RC
tempered 265 °C

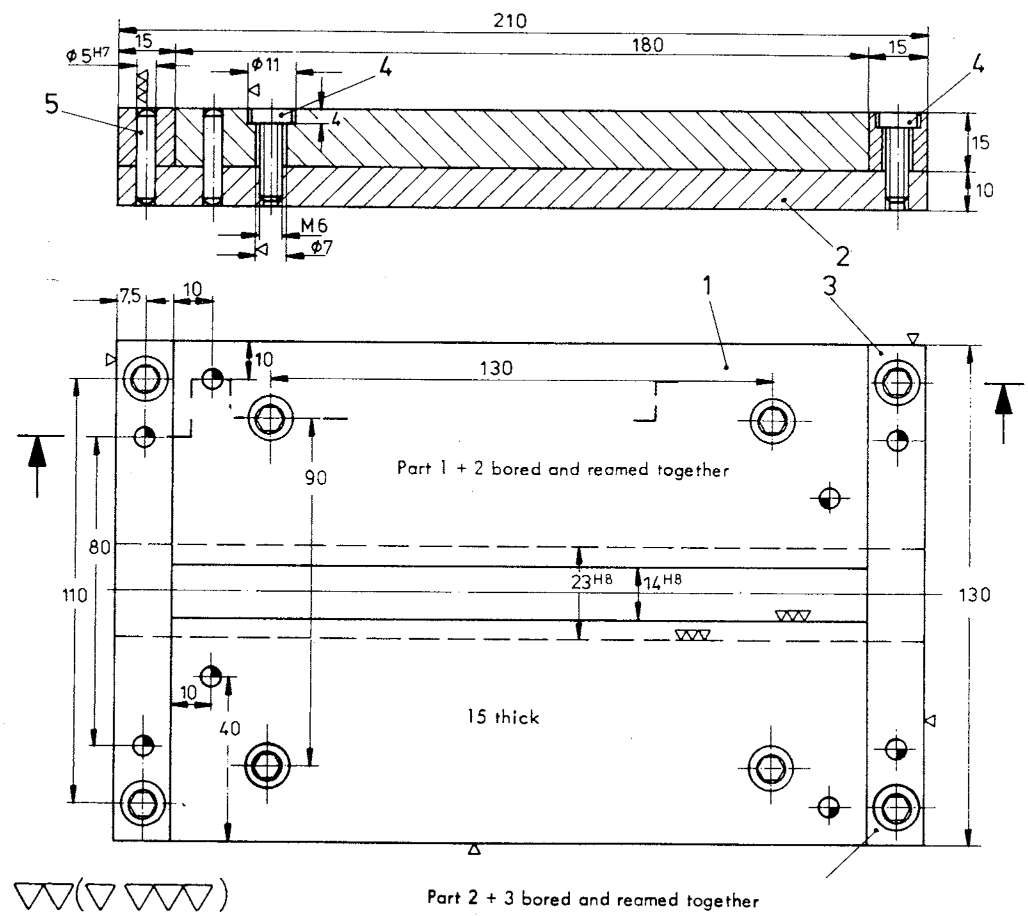
Bore made to match Part 1,
Part 2 brazed to Part 3 .

SPECIAL TOOLS

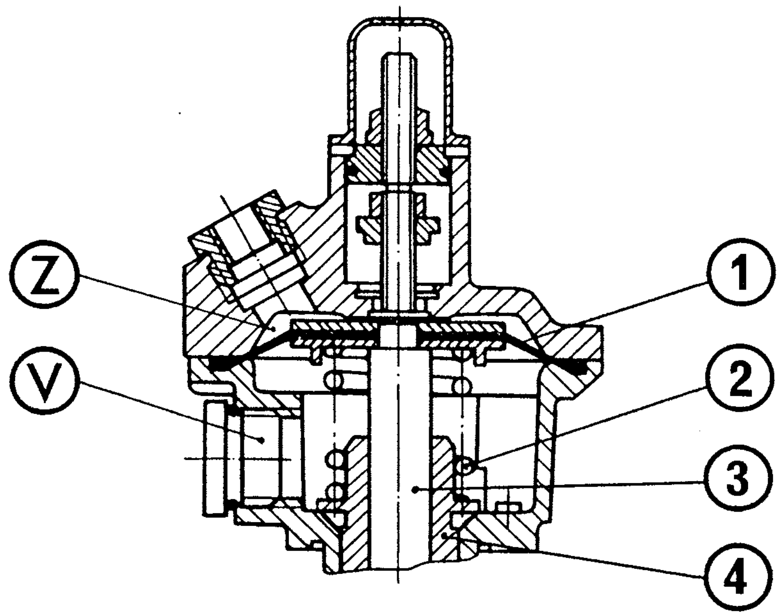
Turbolader

Gültig: 5900 008 25 32 06.84 D
Ersetzt: 5900 008 25 32 01.81 D

Test Equipment for Checking Rotor
True Running (1582036)



Item	Qty.	Denomination	Material	Dimensions	Std.
1	2	Flat bars	St-50K	180 x 60 x 15	17 100
2	2	Flat bars	St-50K	210 x 60 x 10	17 100
3	2	Flat bars	St-50K	130 x 15 x 15	17 100
4	10	Cheese hd. bolt	10.9	M6 x 18	7984
5	8	Cylindr. pins	St-50K	5m6 x 20	7
6	2	T-groove stones	St-50K	14	508
7	2	Cheese hd. bolt	10.9	M12 x 25	912
8	4	Cylindr. pins	St-50K	5m6 x 15	7


Z
V
1
2
3
4

FUEL INJECTION PUMPS WITH ANEROID DEVICE (BOOST PRESSURE CONTROLLED FUEL LIMITER)

General

The exhaust gases of the engine are utilized to drive the turbine rotor of the turbocharger. The compressor impeller which is mounted on the same shaft draws in fresh air which is compressed and supplied to the cylinders for combustion. In this way, much more weight of air is delivered to the combustion chambers ("turbocharging" principle) than on a naturally aspirated engine.

The extra weight of air supplied by the turbocharger is not uniform over the entire engine speed range; mostly, turbochargers are optimized for the upper speed range. As a result, there is less turbocharging at lower engine speeds (i.e. below max. engine torque). With the engine running up to service speed, the turbocharger - being driven by exhaust gases - supplies the extra air for combustion with delay only. This causes smoke emission while the engine runs at low speed.

In order to achieve complete combustion of the injected fuel, a balanced air/fuel ratio, an aneroid device, i.e. a manifold-pressure controlled fuel limiter, is provided, limiting the amount of fuel injected at lower engine speeds. This renders combustion smokeless and makes the engine compatible with the environment.

Method of operation of aneroid device

The aneroid device controls the fuel injection volume in relation to the manifold-pressure (that is the charge or boost air pressure in the combustion air manifold behind the exhaust gas driven turbocharger). The aneroid device operates only at engine speeds below 1600/min.

Space "Z" is connected to the charge air manifold via a pipe. The charge air pressure acts on a diaphragm "1" and - at a certain pressure - overcomes the force of spring "2" so as to push pin "3" downwards. Through a lever, pin "3" releases the previously limited injection pump control rod travel and the full fuel charge can be injected.

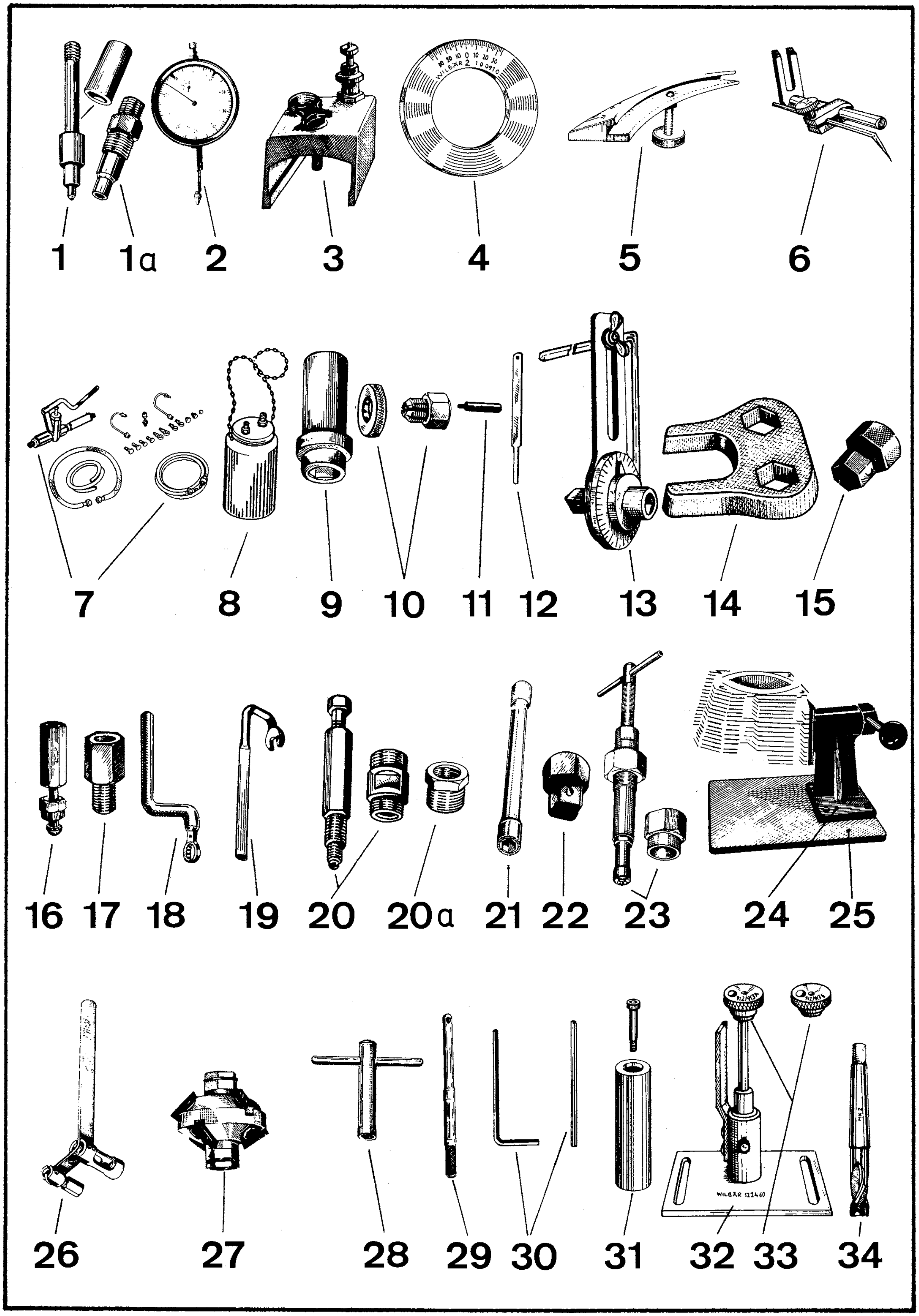
The preload of spring "2" is set by BOSCH by means of spring plate "4". This spring plate has a serrated periphery and can be adjusted toothwise from the outside after removal of plug "V". Pay attention to the right turning direction:

Turning spring plate to the right	=	fuel limited at higher manifold-pressure, and
turning spring plate to the left	=	fuel limited at lower manifold-pressure

For repairing the aneroid device, contact KHD or BOSCH repairshops. Repair guidelines are given in the BOSCH test brochure.

11. Special tools

B/FL 912/913


1
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20a
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WILBÄR 122460
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Abb.-Nr. Fig.-No.	No*	F 2 L 912	F 2 L 912 W	F 3-6 L 912	F 3-6 L 912 W	BF 6 L 912	FL 913	BFL 913	Deutz No.	
1	100020	x		x		x	x	x	003-0464	Fitting of the recorder of compression pressure
	100050	x		x		x	x	x	003-1091	
1a	100040		x		x				003-0602	
2	100400	x	x	x	x	x	x	x	003-0543	Dial gauge 0.01 mm for adjusting and measuring devices
3	100640	x	x	x	x	x	x	x	003-0498	Adjusting device for determining the top dead centre, in connection with dial gauge 100400 and corresponding dial segments and pointers
4	100900			x	x	x	x	x	003-1110	Graduation magnetic for checking injection pump timing, used on freely accesible V-belt pulleys
	100910	x	x	x	x	x	x	x	003-1189	
5	100940	x	x	x	x	x	x	x	003-0677	Dial segments for V-belt pulleys
6	101300	x	x	x	x	x	x	x	003-0678	Pointer for dial segments
7	101500	x	x	x	x	x	x	x	003-0714	High-pressure hand feed pump
8	101510	x	x	x	x	x	x	x	003-0777	Waste receiver for high-pressure hand feed pump
9	101600			x	x	x	x	x	003-0734	Socket spanner for housing of expanding pin
10	101610			x	x	x	x	x	003-0735	Holder of dial gauge
11	101620			x	x	x	x	x	003-1088	Extension pin for dial gauge
12	101630			x	x	x	x	x	003-0736	Feeler gauge 0.2 x 3 mm
13	101910	x	x	x	x	x	x	x	003-1102	Gauge for reading tightening degrees for big-end-, main bearing- and flywheel bolts
14	110010		x		x				003-0586	Special spanner for nozzle holder in connection with 110020 and 120040
15	110020		x		x				003-0581	Double socket insert, in connection with 110010 and 120050
16	110030	x		x		x	x	x	003-0463	Extractor for injectors, to be used with tool 150800
17	110050	x		x		x			003-0422	Threaded piece in combination with 150800 for extracting the injectors
18	110310			x	x	x	x	x	003-0778	Special spanner for adjusting the commencement of delivery (A inj. pump)

* - Spezialwerkzeug-Nr., Special tool-No., No. d' outil spécial, Herramienta especial-No.

Abb.-Nr. Fig.-No.	No*	F 2 L 912	F 2 L 912 W	F 3-6 L 912	F 3-6 L 912 W	BF 6 L 912	FL 913	BFL 913	Deutz No.	
19	110390						x	x		Special spanner for adjusting the commencement of delivery. Advance/retard unit with cone dia. 25, MW inj. pump
20	110340	x	x	x	x	x	x	x	003-0762	Universal device for pulling off the advance/retard unit and rigid drives
20a	110400						x	x		Aux. threaded piece for removing advance/retard unit with cone dia. 25.
21	120040	x	x	x	x	x	x	x	003-0512	Socket spanner for cylinder head bolts
22	120060	x	x	x	x	x	x	x	003-0511	Square socket insert for plug on cylinder head
23	120630	x		x		x	x	x	003-0434	Device for removing the gasket under the injector
24	120900	x	x	x	x	x	x	x	003-0562	Swivelling clamping stand for cylinder head
25	120910	x	x	x	x	x	x	x	003-0794	Clamping plate for 120900
26	121120	x	x	x	x	x	x	x	003-0504	Valve spring compressor
27	122302	x	x	x	x	x	x	x		Cutter for valve seat ring
28	122304	x	x	x	x	x	x	x	003-1043	Holder
29	122305	x	x	x	x	x	x	x		Guide mandrel Ø 8 mm
30	122306	x	x	x	x	x	x	x	003-1044	Accessoires
31	122450	x	x	x	x	x	x	x	003-1234	Mandrel for turning off the valve seat rings on a lathe
32	122460	x	x	x	x	x	x	x	003-0649	Upright drill for cutting out valve seat insert rings
33	122461	x	x	x	x	x	x	x	003-0650	Extra for drilling device No. 122460 Pilot pin with drilling bushes
34	122463	x	x	x	x	x	x	x	003-0652	Hard metal-tipped special cutter

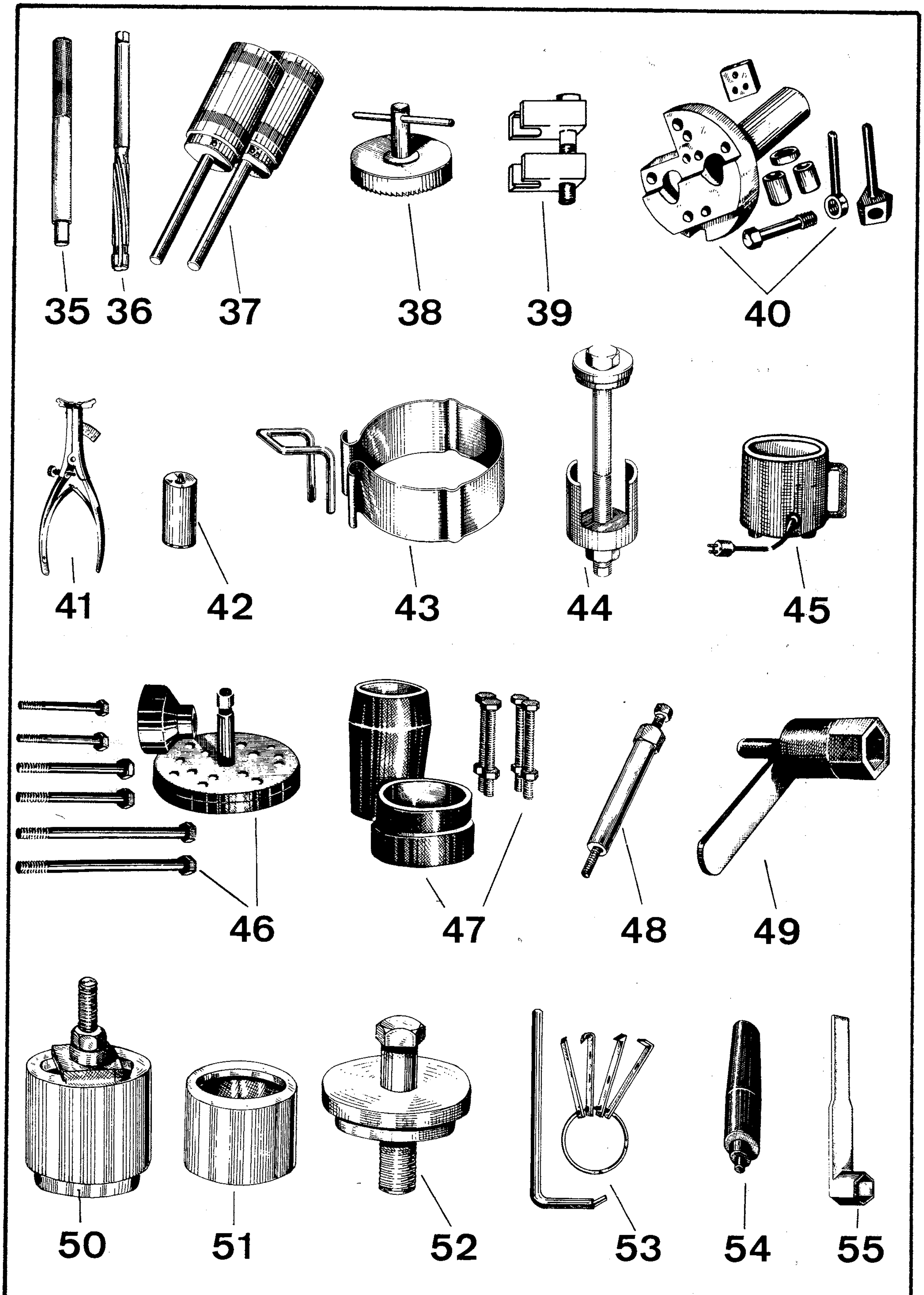
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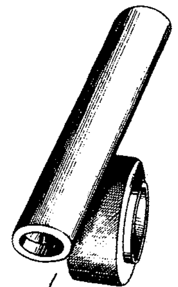
Abb.-Nr. Fig.-No.	No*	F 2 L 912	F 2 L 912 W	F 3-6 L 912	F 3-6 L 912 W	BF 6 L 912	FL 913	BFL 913	Deutz No.	
35	123310	x	x	x	x	x	x	x	003-0453	Mandrel for valve guides Ø 8 mm
36	123510	x	x	x	x	x	x	x	003-0452	Reamer for valve guides Ø 8 mm
37	123960	x	x	x	x	x	x	x	003-0620	Mandrel for valve seat rings
	123950	x	x	x	x	x	x	x	003-0441	
38	124480	x	x	x	x	x	x	x	003-0426	Cutting device for cylinder-head sealing surface
39	125310	x	x	x	x	x	x	x	030-1179	Compressing tool for fitting the protective tubes of the pushrods
40	125500	x	x	x	x	x	x	x	003-0621	Lathe fixture for cylinder heads, for remachining the seat face on a turning lathe
41	130300	x	x	x	x	x	x	x	003-0496	Piston ring plier
42	130360	x	x	x	x	x	x	x	003-0438	Gauge for measuring wear of keystone-ring groove in piston
43	130530	x	x	x	x	x			003-0430	Piston ring compressing device Ø 100 mm
	130600						x	x	030-1029	Piston ring compressing device Ø 102 mm
44	131310	x	x	x	x		x		030-1079	Device for inserting and removing the bushes of the gudgeon pin
	131320					x		x	003-0623	
45	139000	x	x	x	x	x	x	x	003-0414	Piston heater
46	141000	x	x						003-0672	Puller device for withdrawing gear, flywheel and hub from crankshaft and bearing housing out of crankcase

* -Spezialwerkzeug-Nr., Special tool-No. , No. d' outil spécial, Herramienta especial-No.

Abb.-Nr. Fig.-No.	No*	F 2 L 912	F 2 L 912 W	F 3-6 L 912	F 3-6 L 912 W	BF 6 L 912	FL 913	BFL 913	Deutz No.	
47	141010	x	x						003-0670	Special device for inserting bearing housing into crankcase and oil seal into bearing housing
48	141020	x	x						003-0671	Special device for inserting inner bearing housing into crankcase
49	141410	x	x						003-0503	Hammer spanner for flywheel nut
50	142500	x	x						003-2498	Assembly device to insert oil seal crankshaft (front, F2L) (rear, B/F 3-6L)
	142530			x	x	x	x	x	003-1221	
51	142510	x	x						003-2499	Assembly device to insert oil seal of crankshaft (rear)
52	142520			x	x	x	x	x	003-1220	Assembly device to insert oil seal of crankshaft (front)
53	142700	x	x	x	x	x	x	x	003-0733	Removing device for the front and rear gasket ring of the crankshaft
54	143000	x	x						003-0674	Mandrel for mounting flywheel on crankshaft
55	143400			x	x	x	x	x	003-0446	Retainer for V-belt pulley



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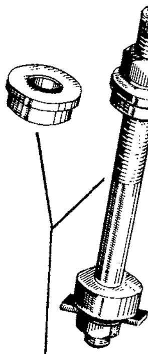

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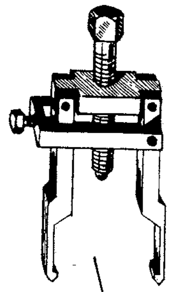

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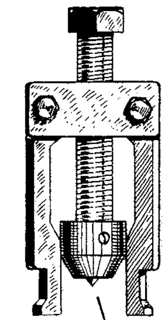

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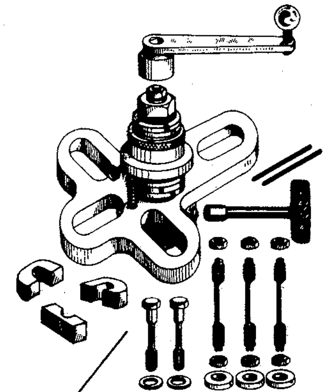

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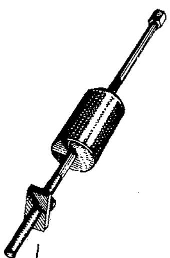

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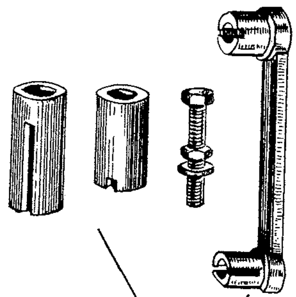

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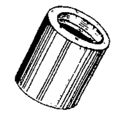

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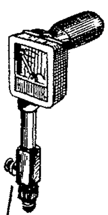

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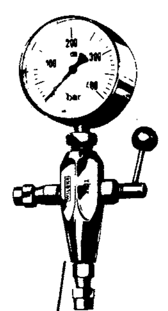

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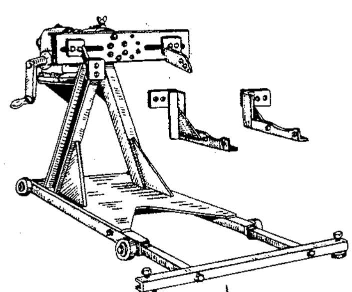

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Abb.-Nr. Fig.-No.	No*	F 2 L 912	F 2 L 912 W	F 3-6 L 912	F 3-6 L 912 W	BF 6 L 912	FL 913	BFL 913	Deutz No.	
56	143610	×	×	×	×	×	×	×	003-0448	Press in device for camshaft hole cover
57	143630	×	×	×	×	×	×	×	003-0433	Device for inserting and removing the bearing-bush of the camshaft
58	144700			×	×	×	×	×	003-0445	Pull-off device for gear on hydraulic pump (old)
59	144750			×	×	×	×	×	003-1134	Pull-off device for gear on hydraulic pump (new)
60	150020	×	×	×	×	×	×	×	003-1133	Refacing device for cylinder seat face on crankcase
61	150800	×	×	×	×	×	×	×	003-0536	Pulling device
62	151100			×	×	×	×	×	003-0798	Special device for splash nozzles for piston cooling
63	160260			×	×		×	×		Mandrel for shaft seal (Oil-controlled fan)
64	170050			×	×	×	×	×	003-0476	Special device to unscrew the oil-strainer
65	2461	×	×	×	×	×	×	×	030-1056	Compressograph
66	3202	×	×	×	×	×		×	003-3345	Special outfit (A-pump)
67	4816/2			×	×	×	×	×	003-1038	Pump lever for hand priming on fuel injection pump (A-pump)
68	6067	×	×	×	×	×	×	×	030-1067	Assembly stand for clamping down air-cooled engines on one only side

* - Spezialwerkzeug-Nr., Special tool-No., No. d'outil spécial, Herramienta especial-No.

Cover and hollow screw required for tuning commencement of injection on F2L 912 using Deutz injection pump.

Drawing for Local Fabrication