

MODELS
D-155, D-179, D-206, D-239
DT-239, D-246, D-268, D-310, D-358
DT-358 and DT-402
DIESEL ENGINES
FORM
CGES-310-1

JANUARY 1982

PAYLINE, TRUCK, AGRICULTURAL
EQUIPMENT AND OEM APPLICATIONS
(Supersedes Form CGES-310)

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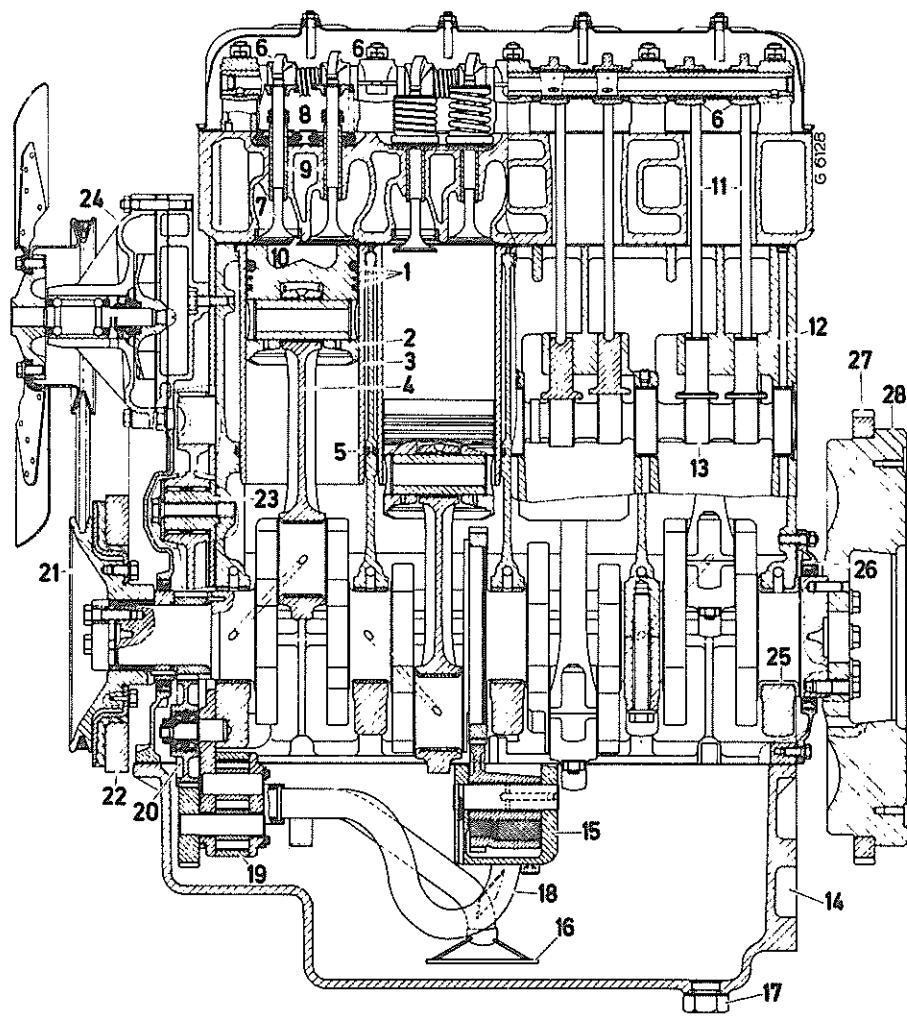
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LONGITUDINAL SECTION OF ENGINE (4-Cylinder Engine)



Illust. 1

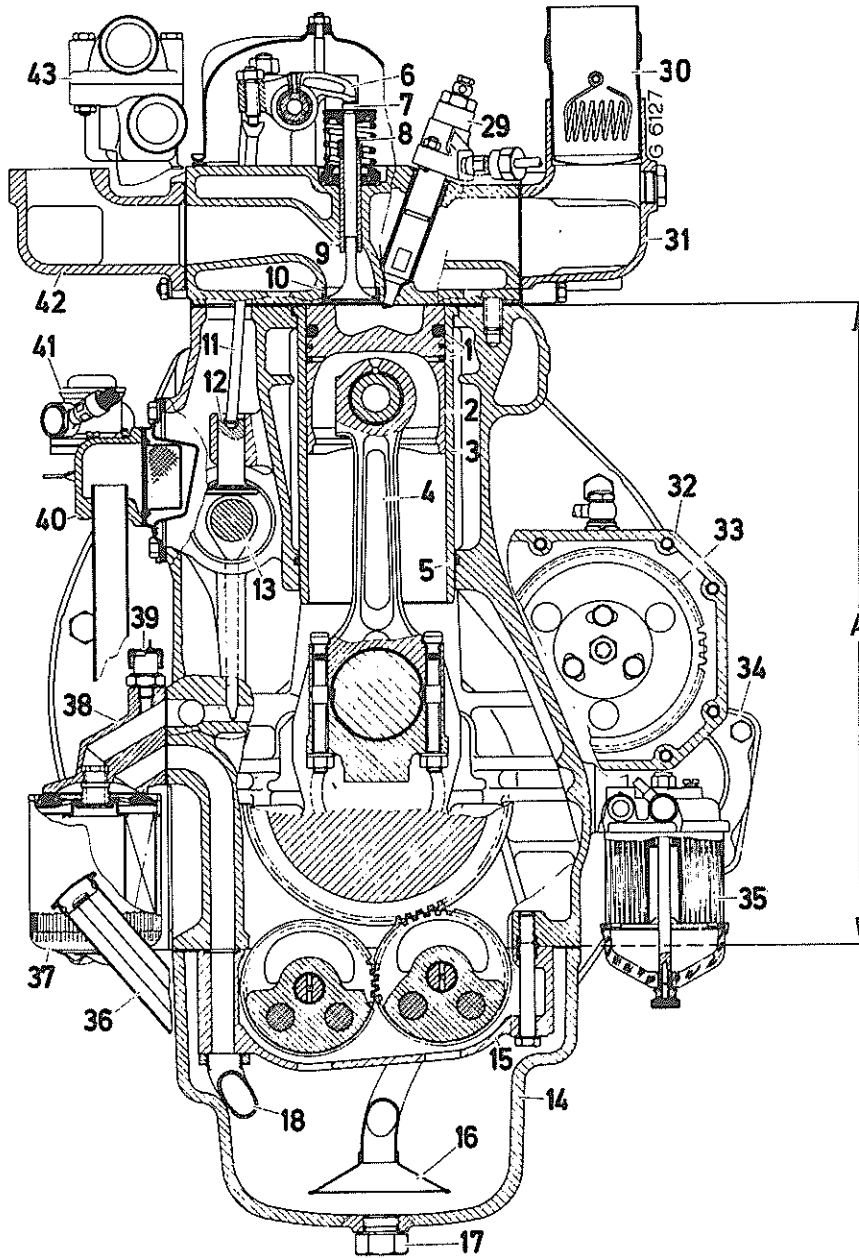
Ref. Nos. apply equally to Illust. 1 and 2

- | | | |
|---------------------------------|---------------------------------|--|
| 1 – Piston rings | 16 – Oil suction Screen | 31 – Manifold, intake |
| 2 – Piston, 3-ring type | 17 – Oil drain plug | 32 – Front plate, crankcase |
| 3 – Cylinder sleeve | 18 – Oil pipe | 33 – Gear, injection pump |
| 4 – Connecting rod | 19 – Oil pump | 34 – Starting motor |
| 5 – O-ring | 20 – Idler gear | 35 – Filter, fuel |
| 6 – Valve lever | 21 – V-belt pulley | 36 – Oil filler neck |
| 7 – Valve, exhaust | 22 – Vibration damper (if used) | 37 – Oil filter |
| 8 – Valve seal | 23 – Idler gear carrier | 38 – Oil filter socket |
| 9 – Valve stem guide | 24 – Water pump | 39 – Oil pressure switch |
| 10 – Valve seat insert, exhaust | 25 – Thrust bearing, crankshaft | 40 – Breather |
| 11 – Valve push rod | 26 – Rear oil seal retainer | 41 – Feed pump, fuel (if so equipped) |
| 12 – Valve tappet | 27 – Flywheel ring gear | 42 – Manifold, exhaust |
| 13 – Camshaft | 28 – Flywheel | 43 – Thermostat (short coolant manifold) |
| 14 – Oil pan | 29 – Nozzle holder | |
| 15 – Balancer | 30 – Heating pipe | |

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**CROSS SECTION OF ENGINE
(4-Cylinder Engine)**



Illust. 2

ENGINE	CYLINDER	BORE		STROKE		DISPLACEMENT		DIMENSION "A"	
		mm	Inch	mm	Inch	Litre	Cubic Inch	mm	Inch
D-155	3	98.4	3.875	111.1	4.375	2.54	155	424.18	16.70
D-179	3	98.4	3.875	128.5	5.059	2.94	179	458.72	18.06
D-206	4	98.4	3.875	111.1	4.375	3.38	206	424.18	16.70
D/DT-239	4	98.4	3.875	128.5	5.059	3.92	239	458.72	18.06
D-246	4	98.4	3.875	128.5	5.059	4.03	246	458.72	18.06
D-268	4	100	3.937	139.7	5.500	4.40	268	464.32	18.28
D-310	6	98.4	3.875	111.1	4.375	5.08	310	424.18	16.70
D/DT-358	6	98.4	3.875	128.5	5.059	5.87	358	458.72	18.06
DT-402	6	100	3.937	139.7	5.500	6.59	402	464.32	18.28

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TYPE**4-Cycle-Diesel-Engines**

Direction of rotation, facing flywheel	L.H.
Compression ratio	16:1 (except D-268 and DT-402) 15:1 (D-268 and DT-402)
Compression at starting speed, MPa (PSI)	2.2-2.4 (313-341)
Firing order	
D-155, D-179	1-3-2
D-206, D-239, D-246, D-268, DT-239	1-3-4-2
D-310, D-358, DT-358, DT-402	1-5-3-6-2-4
Valve clearance, engine hot	0.30 mm (.012 in.)

COOLING SYSTEM

Most favorable operating temperature	90°-95°C (194°-203°F)
--------------------------------------	-----------------------

AIR SYSTEM

Max. permissible restriction before servicing the air cleaner	635 mm (25 inch) of water
---	---------------------------

LUBRICATING SYSTEM

Oil pressure at rated speed, Pa (PSI)	303-414 (44-60)
Oil pressure at low idle speed and 90°C (194°F) oil temperature, Pa (PSI)	min. 90 (12.8)
Lubricant	see "Operator's Manual"
Oil consumption, less than	1 g/HP hr

INJECTION SYSTEM

Injection pump	Robert Bosch Rotary
Nozzle opening pressure: Flange mounted nozzle holder, MPa (PSI)	20-21 (2845-3000)
Nozzle opening pressure: Crab mounted nozzle holder, see "Nozzle Holder Combinations" Page 177	

ELECTRICAL SYSTEM

Alternator	"Bosch" 14 V-28 A 14 V-35 A 14 V-55 A 28 V-27 A 28 V-45 A
Starting Motor	"Bosch" 12 V 3kW (4 HP) 24 V 4kW (5.3 HP) 24 V 4.8kW (6.4 HP)

Crankcase Pressure and Blow-by Chart

Engine	Max. Crankcase Pressure (High Idle, No Load)		Max. Permissible Blow-By		
	mm H ₂ O	in H ₂ O	RPM	at Engine Idling cu. m./hr (cu. ft./hr)	at Rated Load cu. m./hr (cu. ft./hr)
D-155	38	1.5	1500 2500	1.0 (35.3) 1.5 (53.0)	2.0 (70.6) 2.5 (88.0)
D-179	38	1.5	2100 2500	1.5 (53.0) 1.5 (53.0)	2.0 (70.6) 2.5 (88.0)
D-206	51	2.0	2100 2500	1.5 (53.0) 1.5 (53.0)	2.5 (88.0) 3.0 (106.0)
*D-239	51	2.0	2100	1.5 (53.0)	2.5 (88.0)
**D-239	114	4.5	2200	1.5 (53.0)	2.5 (88.0)
DT-239	152	6.0	2500	2.0 (70.6)	3.5 (123.0)
D-246	51	2.0	2500 2 00	2.0 (70.6) 2.0 (70.6)	3.0 (106.0) 3.5 (123.0)
D-268	51	2.0	2500 2200 2300	2.0 (70.6) 1.5 (53.0) 2.0 (70.6)	3.0 (106.0) 3.5 (123.0) 3.5 (123.0)
D-310	64	2.5	2400 3000	2.0 (70.6) 2.0 (70.6)	3.5 (123.0) 4.0 (141.0)
D-358	127	5.0	2200 3000	1.5 (53.0) 2.0 (70.6)	3.0 (106.0) 4.0 (141.0)
DT-358	165	6.5	2200 2500	4.0 (141.0) 4.0 (141.0)	6.0 (212.0) 6.0 (212.0)
DT-402	165	6.5	2200 2500	2.0 (70.6) 2.0 (70.6)	3.0 (106.0) 3.0 (106.0)

*With rectangular top ring

**With full keystone top ring

NOTE: Refer to "Checks" for testing procedure and proper tools.

IMPORTANT

Pressure readings obtained must not be used as the main source of engine condition. Oil consumption trend data must also be used if the pressure readings are beyond the specified limits. Neither changes in oil consumption trends nor crankcase pressure trends can establish a specific component problem but are only indicators that some problem exists.

Static Timing (Degrees BTDC) *

D - 155	*
423, E-423	10
383	10
500 C/E	12
453	10
V/E-433, V/E-533	10
V/E 433 Series II	8
V/E 533 Series II	10
S.U. 533	10
5033	12
433	8
533	10

D - 179	
553	14
633	14
4500 B T.C.	14
454 G.D./454 H.S.	14
464 G.D./H.S.	14
3654 S.U.	14
484, 248 IT	14
SU-644-LD	14
2454 G.D./H.S.	14
240A S.M./H.S./T.C.	14
3400 A G.D./H.S.	14
2400 A G.D./H.S.	14
Irrigation - Unit	14

D - 206	
554, 654, 644	12
221	14
TD-7 C G.D.	12
100 G.D.	12
733	12
474 G.D./H.S.	14
100 B Series II	10
584	12
TD-6 B	10
100 B, 624	10
258 IT	12
624 (Mexico)	12

D - 239	*
DT - 239	
724, 734	14
824, 744 S.U.	16
824, 834, 744 Crane	16
TD-7 E, 100 E P.S.	12
TD-8 C, P.S.	12
125 G.D./P.S.	14
H-30 B, Galion Gr.	16
H-30 B Nico	16
321, 431	12
Ingersoll-Rand	16
5000/5500 W.R.	16
1130/1230 TOE	12
743, 745 S	16
574 H.S.	16
574 G.D.	12
3654, 3654 S.U.	14
3500 A G.D./H.S.	14
674 G.D.	14
2500 A G.D.	12
125 B u. TD-8B Ser. II	12
S.U. 644-H.D. 4-WD.	14
3400 B S.M. H.S./T.C.	18
684	16
2574 G.D.	12
250 A. S.M.	12
260 ATC SM./H.S.	18
Irrigation Unit	18
2500 AH.S.	14
2574 H.S.	14
250 A H.S./T.C.	14

D - 246	*
824	18
834	18
844	18
784	16
84 Hydr.	16
268 IT	16
278 IT	16

D - 268	
844 S	8
845	8
620 B	8
510	18
TD-8 CA	8
884	16
270 A	16

D - 310	
946 (2100 RPM)	16
946 (2200 RPM)	10
686	14
766	10
955	12
431, 531	16
H-50 B	12
DU-2 D	16
D-1500 C	18
616/622 H.S.	16
711 S.P. Header Harv.	10
165 C	8
696	14
I-3820 A	14
9000 F.L.	14
715 Comb.	12
782 Cotton Picker	16
786	10
86 Hydr.	8

D - 358	*
DT - 358	
1055, 955	14
1630 A, 1730 A, 1830 A	18
531, 541, (8-111)	18
Acco 1820 with AT-540	18
1730 B - 1930 B	18
Galion 102 Grader	16
DU-2 D	16
H-60	16
Series 200 ATk. M.T.	18
1046	16
1521 S	18
725 SP	14
H 65 B	17
866-HS (Austr.)	16
3964/3965	18
3980	16
515	16
976, 986, 886 (U.S.)	16
S-8A, S-10	16
H-60-B, 520 A	16
H-65 C	16
530 A	16
943	18
953	16
923	16
933	18
1420	10
3990	16
650	16
3980 B/3984 B	20
630	18
280 PH	20
1246	16
1255	8
786	18
1400	12
Irrigation - Unit	16
640 (D - 358)	16
640 (DT - 358)	20

DT - 402	
3994, 650 HD	16
953 HS, 953 GD	16
1455	14
530 AS II	16

SPECIAL SERVICE TOOLS REQUIRED

TOOL DESCRIPTION	AGRICULTURAL EQUIPMENT	* (FES)	CONSTRUCTION EQUIPMENT	TRUCK EQUIPMENT
Piston Ring Drop Fixture	04-68-3	(68-3)	PLT-501	SE-2206
Camshaft Bearing Remover/Installer Set	04-101	(101)	PLT-543	—
ENGINE TOOL KIT	— — —		PLT-511	—
Rear oil seal installing tool	04-149-2	(149-2)	PLT-511-1	—
Installing tool spacers	04-149-21	(149-21)	PLT-511-2	—
Injection nozzle sleeve pulley	17-25-12	(25-12)	PLT-509-11	—
Engine valve guide driver	04-112-5	(112-5)	PLT-511-4	—
Cylinder head offset wrench	04-112-6	(112-6)	PLT-511-5	—
Cylinder head special bolt wrench	04-112-8	(112-8)	PLT-511-6	—
Front engine seal installer	04-112-7	(112-7)	PLT-511-7	—
Cylinder Deglazer Brush	04-130-4	(130-4)	PLT-547-4	SE-2314-4
Valve Guide Cutter	04-145	(145)	—	—
Nozzle Sleeve Installer	04-148-2	(148-2)	PLT-510-2	—
Valve Spring Compressor	04-462	(462)	—	SE-1846
Piston Ring Compressor	04-464-2	(464-2)	—	SE-1610
Cylinder Ridge Reamer	04-467	(467)	—	SE-1405
Cylinder Hone	04-468	(468)	—	SE-1574
Valve Guide Reamer	04-478-1	(478-1)	PLT-545	—
Pressure/vacuum Compound Gauge	14-1-3	(1-3)	PLT-866-3	—
Male Connector	14-2-78	(2-78)	PLT-864-62	—
Hose Assembly	14-2-33A	(2-33A)	PLT-864-23)	—
"O" Ring and Packing Tool	14-57-3	(57-3)	PLT-106	—
Pressure Snubber	14-94-6	(94-6)	PLT-860-6	—
Thermomelt Pencil 198°C (388°F)	15-115-1	(115-1)	PLT-118-1	—
Thermomelt Pencil 93°C (200°F)	15-115-3	(115-2)	PLT-118-3	—
Dial Indicator	15-67-1	(67-1)	PLT-102-1	—
Valve Spring Tester	15-233	(233)	PLT-100	—
Compression Tester	15-13-1	(13-1)	PLT-519-1	—
Compression Tester Adapter	15-14-2	(14-2)	PLT-520-2	—
Nozzle cup nut	and 3 056 945 R1		and 3 056 945 R1	
Copper sealing washer	116102		116102	
Diesel Timing and Tachometer Kit	15-3005	(3005)	PLT-301	SE-2528
Nozzle Tester	15-71A	(71)	PLT-360	SE-2002
Nozzle Tube Assembly	15-72-1	(72-1)	PLT-360-1	SE-2004-13
Adapter	15-72-2	(72-2)	PLT-360-2	SE-2757
Hose Assembly	15-72-3	(72-3)	PLT-361-3	—

* (FES) refers to old numbering system

SPECIAL SERVICE TOOLS REQUIRED

TOOL DESCRIPTION	AGRICULTURAL EQUIPMENT	* (FES)	CONSTRUCTION EQUIPMENT	TRUCK EQUIPMENT
Fuel rator with fittings and hoses	15-136	(136)	—	—
Fuel Diverting Kit	15-132	(132)	—	—
Injection Pipe Assembly (For use on D-239 Engine)	15-132-10	(132-10)	—	—
Diesel Field Test Kit	15-126	(126)	—	—
Engine Stand	17-52A	(52)	PLT-540	
Engine Attaching Plate	17-52-11	(52-11)	PLT-540-2	
Nozzle sleeve puller adapter (Use with slide hammer with 5/8" - 18 thread)	17-25-12	(25-12)	PLT-509-11	
Universal Wet Sleeve Puller	17-22-2	(22-2)	PLT-502-3	SE-2536
Injection Nozzle Puller	05-46	(46)	PLT-359	—
Injection Pump Kit (Includes:	— — —		PLT-357	— — —
Holding fixture	05-111-1	(111-1)	PLT-357-1	—
Drive hub puller	05-111-2	(111-2)	PLT-357-2	—
Combination metric wrench	— — —		PLT-357-3	—
Delivery valve gasket remover	05-111-4	(111-4)	PLT-357-4	—
Timing window	05-111-5	(111-5)	PLT-357-5	—
Banjo fitting	05-111-6	(111-6)	PLT-357-6	—
6mm Allen wrench	— — —		PLT-357-7	—
Control plunger spring pre-load tool)	05-111-8	(111-8)	PLT-357-8	—
Nozzle Orifice Cleaning Needle Kit	05-131	(131)	PLT-368	SE-2202
SAE Test Nozzle	05-137-20	(137-20)	PLT-375-1	—
"CR" Injection Pump Kit (Includes:	05-504	(504)	PLT-356	— — —
Timing window adapter	05-504-1A	(504-1A)	PLT-356-1	—
Pressure port adapter plate	05-504-2	(504-2)	PLT-356-2	—
Rotor retainer	05-504-3	(504-3)	PLT-356-3	—
Alignment tool	05-504-4	(504-4)	PLT-356-4	—
Shaft seal protector	05-504-5	(504-5)	PLT-356-5	—
Slide hammer	05-504-6	(504-6)	PLT-356-6	—
Bullet tool (seal)	05-504-7	(504-7)	PLT-356-7	—
Bullet tool (seal)	05-504-8	(504-8)	PLT-356-8	—
Roller Assembly retainer	05-504-9	(504-9)	PLT-356-9	—
Plastic box	05-504-10	(504-10)	PLT-356-10	—
Timing window	— — —		PLT-357-5	—
Control plunger gauge)	05-504-11	(504-11)	PLT-356-11	—
Counterbore Tool (Includes:	—		PLT-546	—
Driver Unit, handle and tool bits	—		1 020 553 R91	SE-2514
Adapter plate	—		1 020 554 R1	SE-2514-1
Tool holder	—		1 020 556 R1	—
Tool bit)	—		1 020 561 R1	—
Depth Gauge (not included in Kit)	—		1 020 560 R91	SE-2515
Crankshaft Balance Weight Socket Adapter	04-575		—	—
Crankcase Pressure Orifice Restrictor	15-533-6		PLT-556	—
Crankcase Pressure Orifice Restrictor	15-533-5		PLT-554	—

* (FES) refers to old numbering system

SPECIAL NUT AND BOLT TORQUE DATA

NOTE: Torque values are in Newtonmeters (N•m) and pound feet (lbs-ft) except where pound inches are specified (#).

	N•m			lbs-ft		
	1st Step	2nd Step	Final Step	1st Step	2nd Step	Final Step
*Balance weight necked-down bolts ***	30	---	58	22	---	43
*Balance weight pitch diameter bolts	60	---	103	44	---	76
*Main bearing cap necked-down bolts 10.9 ***	40	80	110	30	59	81
*Main bearing cap necked-down bolts 12.9 ***	40	80	135	30	59	100
*Main bearing cap pitch diameter bolts 12.9	40	80	195	30	59	144
*Main bearing cap pitch diameter bolts 10.9	40	80	145	30	59	107
*Connecting rod nuts	25	---	□	18	---	□
*Annular spring tightener element or clamping ring	30	60	63	22	44	46
Idler gear necked-down bolt *	---	---	93	---	---	69
**Idler gear pitch diameter bolt	30	70	103	22	52	76
*Flywheel bolts	40	80	145	30	59	107
Bolts, seal ring retainer, rear	15	---	19	11	---	14
*Cylinder head nuts ***	40	80	120	30	59	89
*Cylinder head studs ***	---	---	55	---	---	41
*Cylinder head cap screws with round washer ***	40	80	115	30	59	85
*Cylinder head cap screws with collar	40	80	149	30	59	110
Valve lever bracket studs	---	---	38	---	---	28
*Valve lever bracket stud nuts	---	---	65	---	---	48
Valve set screw — clamping movement	---	---	31	---	---	23
Valve lever bracket clamping screw	---	---	11	---	---	(97)#
Side cover screws	---	---	17	---	---	13
Engine breather screw (use new packing ring)	---	---	9	---	---	(80)#
Oil pressure gauge	---	---	Max. 10	---	---	(Max. 88)#
Temperature sender unit	---	---	Max. 20	---	---	Max. 15
Exhaust manifold stud nuts	---	---	38	---	---	28
Exhaust manifold stud	---	---	38	---	---	28
Nozzle holder stud	---	---	16	---	---	12
Nozzle holder stud nuts	5	---	11	(44)#	---	(97)#
Nozzle union nut	---	---	70	---	---	52

()# Represents pound-inch.

* Oil while mounting.

** Use liquid locking compound while mounting (Loctite # 271).

*** No longer used in production.

□ After pre-torque tighten additional two edges or 120°.

SPECIAL NUT AND BOLT TORQUE DATA – Continued

NOTE: Torque values are in Newtonmeters (N•m) and pound feet (lbs-ft) except where pound inches are specified (#).

	N•m			lbs-ft		
	1st Step	2nd Step	Final Step	1st Step	2nd Step	Final Step
*Bolt } Crab Mounted	---	---	25	---	---	18
Nozzle union nut } Nozzle Holder	---	---	60	---	---	44
Nozzle holder leak oil connection hollow screw	---	---	5	---	---	(44)#
Injection line union nuts	---	---	23	---	---	17
Valve cover adapter stud	---	---	17	---	---	13
Valve cover stud nut	---	---	6	---	---	(53)#
Valve cover screw	---	---	6	---	---	(53)#
Valve cover housing bolt	---	---	16	---	---	12
Oil pan drain plug (when asbestos-filled packing ring is used)	---	---	55	---	---	41
Oil pan drain plug (when copper ring is used)	---	---	145	---	---	107
Plug with socket head (oil gallery-crankcase)	---	---	Max. 12	---	---	Max. 9
Injection pump gear bolt	15	---	27	11	---	20
Injection pump cover bolt (tighten crosswise)	4	---	9	(35)#	---	(80)#
Injection pump flange nut	15	---	24	11	---	18
Injection pump plunger end plug	---	---	50	---	---	37
Injection pump drive shaft nut (for VA injection pump)	---	---	65	---	---	48
Injection pump drive shaft nut (for VE injection pump)	---	---	93	---	---	69
Hollow screws (SW17 and SW19)	---	---	23	---	---	17
Bolts, sheet metal oil pan	---	---	13	---	---	10
Bolts, grey iron oil pan	---	---	32	---	---	24
Turbocharger V-Clamp	---	---	12	---	---	9
Front P.T.O. Clamping Ring Capscrew	15	---	29	11	---	21
Support Angle Bolt (for VE injection pump)	---	---	8	---	---	(71)#

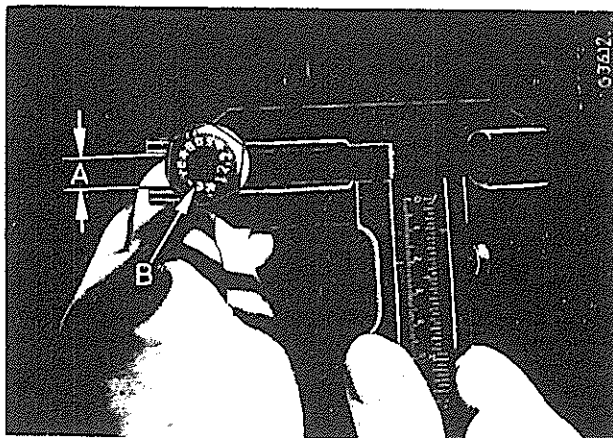
()# Represents pound-inch.

* Oil while mounting.

** Use liquid locking compound while mounting (Loctite #271).

*** No longer used in production.

IDENTIFICATION OF DIFFERENT BOLTS



Illust. 3

- A — Shaft diameter
 B — Stamping on bolt head

- A — Different shaft diameter
- | | |
|--------------------------------------|------------------|
| Main bearing bolts, necked down | 10.4 mm = .4094" |
| Main bearing bolts, pitch diameter | 12.7 mm = .4999" |
| Balance weight bolts, necked-down | 8.6 mm = .3385" |
| Balance weight bolts, pitch diameter | 10.2 mm = .4015" |
| Idler gear bolt, necked-down | 9.6 mm = .3779" |
| Idler gear bolt, pitch diameter | 11.3 mm = .4449" |
- B — Different stamping on bolt head, e.g. 10K, 12K, 10.9, 12.9 or a circular stamping on idler gear pitch diameter bolt

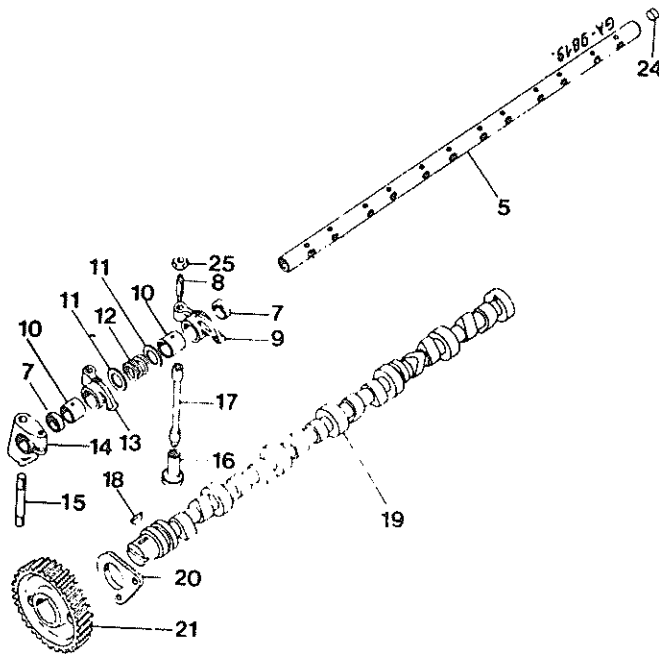
Note: Same bolts receive a special shot peening treatment at the engine assembly line. It is important, therefore, to use only the specified bolts to comply with our quality standards.

Where local manufacture of special tools is recommended, details are shown in the respective sections of this manual.

SPECIAL TOOLS

"International" Diesel engines are designed so that few service tools are required other than those in the mechanic's tool kit. However, when the use of inexpensive special tools will facilitate work, such equipment is mentioned in this manual.

VALVE LEVER ASSEMBLY



Illust. 4

General

The valve lever assembly receives its lubrication through the hollow valve lever shaft. Oil holes are provided in the valve lever shaft (5) Illust. 5 to lubricate individual valve levers.

An oil port is provided in the shaft which must line up with the respective oil-way in the bracket. The mark (3) Illust. 9 must be in line with the clamping slot of the front bracket. Replaceable oil plugs (24) Illust. 4 are used to close up both ends of the shaft.

Valve levers for intake and exhaust valves differ in length but are provided with the same replaceable bushings which must be reamed to size after installation.

Replacement levers are supplied with bushings in place.

Specifications

In brackets () max. permissible wear before reconditioning.

Valve lever shaft, dia	21.593–21.568 mm = .850–.849" (0.03 mm = .0012" out of round)
Valve lever bushing, dia	21.615–21.640 mm = .851–.852" (0.03 mm = .0012" out of round)
Clearance on shaft	0.022–0.062 mm = .0009–.0025" (+ 0.5 mm = .020")
Radius on contact end (3) Illust. 6	12.70 mm = .050"
Hardness on radius	RC 55
Depth of hardness	0.8 mm = .031"
Spring (12) Illust. 4, Free length	37.7 mm = 1.48"
Test length	25.0 mm = 1.00"
Test load	29N = 3 kg = 6.6 lbs.

Removal and Disassembly

Thoroughly clean the engine externally.

Remove valve housing cover.

Remove nuts from studs (1) Illust. 5 and lift the complete valve lever assembly clear of the cylinder head. Loosen clamping bolts (2) and press in brackets slightly towards the center, taking care they do not slide off the shaft, resulting in levers and springs, etc. being scattered all over the floor. Slide all parts off the shaft and place them on a table in removal order to facilitate correct reassembly.



Illust. 5

- 1 – Stud nuts
- 2 – Clamping bolts
- 3 – Bracket, front
- 4 – Bracket, rear
- 5 – Spring

Cleaning, Inspection and Repair

Clean all parts in kerosene or Diesel fuel and blow dry with compressed air. Be sure all oil passages are free from sludge and sediment.

Check valve lever shaft, lever bushings, thrust washers, and spacer rings. Check bushings and valve lever shaft for scoring and out-of-round wear and replace, if necessary. Use a suitable drift punch and press plate and drive bushings out of valve levers.

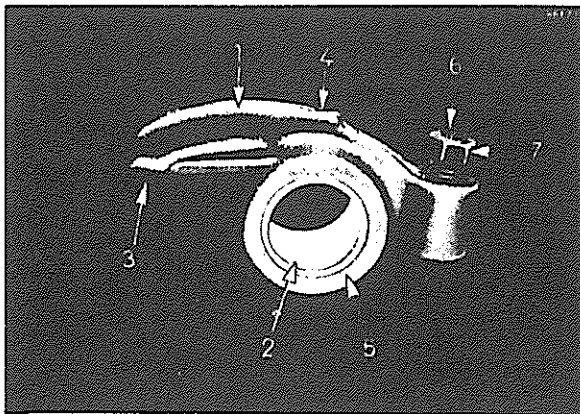
Install new bushings (2). The new bushing must be flush with the two side faces (5) (Illustr. 6). Use a 3 mm = 1/8" drill to open the oil passage (4) in the bushing and remove chips and burrs. Bream the bushing to size, see "Specifications"

Valve Lever

Regrind valve levers that show excessive wear or hammering at the ends (3) which contact the valves. Remove only enough material to give an even face on the end of the valve lever and take care that the rounding is maintained lengthways to assure perfect gliding action on the valve stem. Be sure that the surface is not ground out of line with the valve lever shaft in the lateral plane as this would place side thrust on the valve stem, thereby causing out-of-round wear on the valve guides.

When reconditioning contact end (3):

- Use special refacing machine.
- Maintain specified radius.
- Be sure depth of hardness is sufficient after reworking.



Illust. 6

- Exhaust valve lever
- Lever bushing
- Valve contact end
- Oil passage, 3 mm \varnothing = 1/8" \varnothing
- Side face
- Valve adjusting screw
- Lock nut

Where appropriate grinding facilities for valve levers are not available it is advisable to install new valve levers as a complete set.

Inspect contact face of the valve adjusting screw (6) for hammering.

Adjusting Screw

Check and replace damaged screws with new ones.

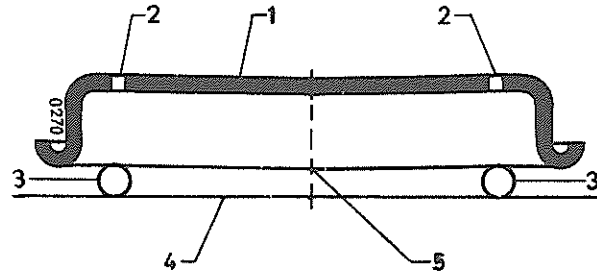
SHAFT

Check for out-of-round. Replace a worn shaft with a new one.

NOTE: New design rocker arm shafts are Deep-Nitro treated so that the surface will be dull, mat gray in appearance, rather than the earlier design induction hardened polished appearance.

Check expansion plugs on both ends of the lever shaft for leakage and replace plugs, if necessary, using liquid sealer. Check valve lever springs against specifications and replace with new ones if signs of corrosion, chafing or fatigue begin to show.

Valve Housing Cover



Illust. 7

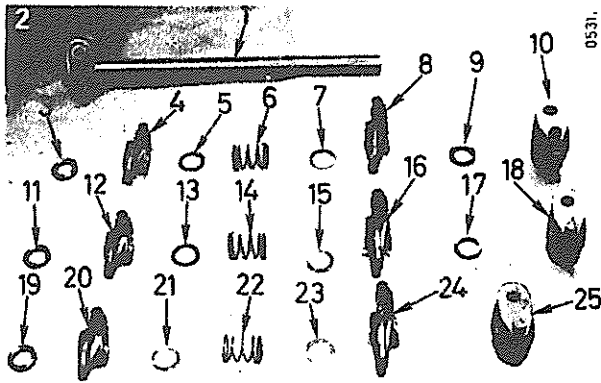
- Valve housing cover
- End holes
- Gauge bars
- Leveling plate
- Measuring point

Inspect valve housing cover for cracks and distortion.

Place the valve housing cover on a leveling plate, Illust. 7. Check the cover contacts bars (3) on four points. A gap up to 0.5 mm = .02" at one point is permissible. Check the height on both cover ends at measuring points (5). A difference up to 1 mm = .04" is permissible. Check valve housing cover also for cracks and other damage.

If cracked or if warpage exceeds above limits, replace.

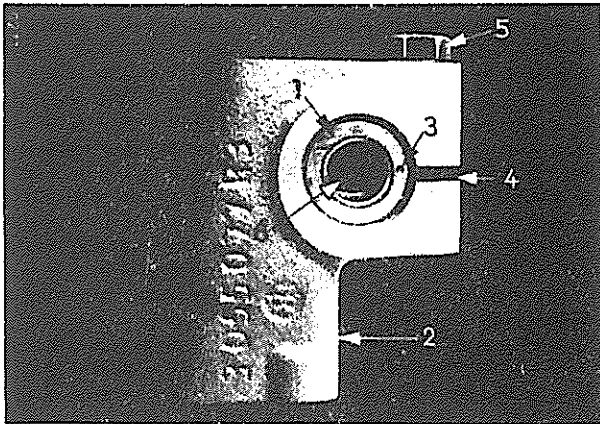
Reassembly and Installation



Illust. 8

Figures of Illust. 8 show sequence of reassembly

Reassemble the valve lever shaft in accordance with Illust. 8 commencing with front bracket (2). Oil all parts before reassembly.



Illust. 9

- 1 - Valve lever shaft
- 2 - Valve lever shaft bracket, front
- 3 - Punch mark
- 4 - Clamping slot
- 5 - Clamping bolt
- 6 - Expansion plug

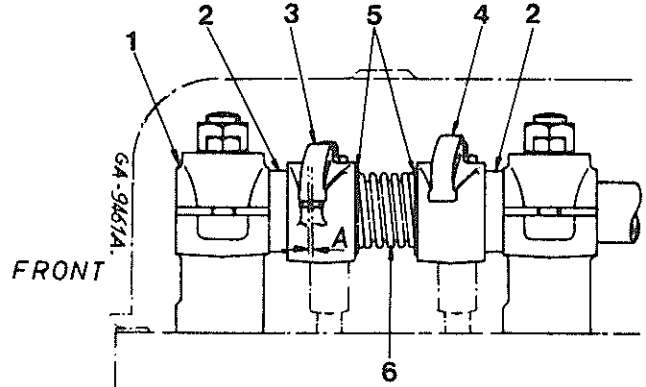
Punch mark (3) Illust. 9 of the shaft must be in line with clamping slot (4). Be sure the shaft end is flush with bracket (2). This will ensure that oil passages in bracket and shaft correspond.

Tighten clamping bolt (5) lightly to secure this adjustment.

Take care to alternate intake and exhaust valve levers.

On reassembly observe the following:

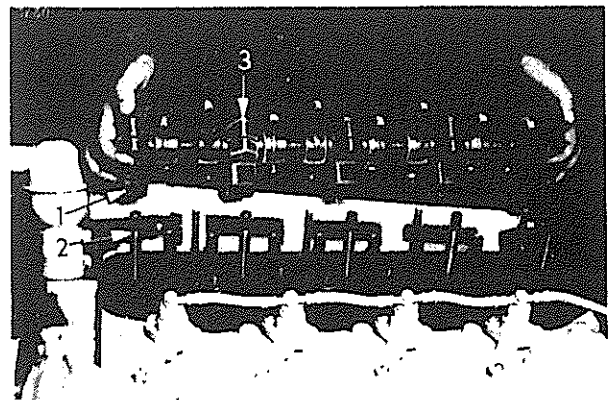
Spacer rings are installed on either side of every inner valve lever shaft bracket and on the inner side of the front bracket (1) Illust. 9a. There is no spacer ring between the rear bracket and the adjacent valve lever.



Illust. 9a

- 1 - Bracket, front
- 2 - Spacer
- 3 - Exhaust valve lever (short)
- 4 - Intake valve lever (long)
- 5 - Washer
- 6 - Spring
- A - Max. 1.2 mm (0.047 in.) deviation of center line between lever and valve stem

Springs (6), located between each valve lever pair, have thrust washers on both sides. Take care to alternate intake and exhaust valve levers. Slide the assembly on studs (2) Illust. 10.



Illust. 10

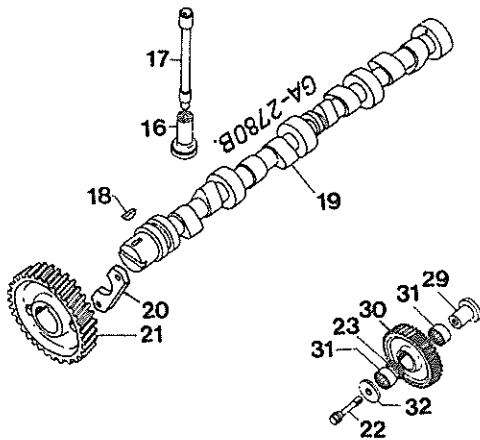
Removal or installation of valve lever shaft assembly

- 1 - Valve lever shaft bracket
- 2 - Stud
- 3 - Clamping bolt

Tighten stud nuts and clamping bolts to specified torque.

Check dimension "A" (Illust. 9a) and adjust valve clearance.

CAMSHAFT, IDLER GEAR, TAPPETS and PUSH RODS



Illust 11

General

The camshaft (19) Illust. 11 (and the injection pump) are driven from the front end of the crankshaft through a train of gears. All gears are punch-marked to ensure correct tuning.

The camshaft is supported in bushings.

End float is controlled by thrust plate (20). The drive gear (21) is keyed and shrunk to the camshaft end.

The camshaft bushings are pressure lubricated from the oil gallery and have drilled holes.

Specifications

In brackets () maximum permissible wear before reconditioning.

Camshaft, Dia (Early type)	29.0–31.0 mm = 1.14–1.22"
Camshaft, Dia (Current type)	30.0–32.0 mm = 1.18–1.26"
Cam lobe width (Early type)	22.0 mm = .87"
Cam lobe width (Current type)	26.0 mm = 1.02"
Cam lobe lift	8.05–8.13 mm = .317–.320"
Cam lobe lift	8.05–8.13 mm (.317–.320")
Journals, Dia	58.00–57.97 mm = 2.2835–2.2823" (- 0.03 mm = .0012")
Bushings, i. Dia	58.054–58.024 mm = 2.856–2.844" (0.03 mm out-of-round)
Camshaft running clearance in bushings	0.024– 0.084 mm = .0010– .0033 (+ 0.03 mm = .0012")
Camshaft end float	0.10 – 0.45 mm = .004 – .018 "
Gear (21) Illust. 11	
Bore, Dia	41.275–41.300 mm = 1.6250–1.6259"
Gear seat, Dia	41.333–41.317 mm = 1.627 –1.6260"
Backlash, Drive Gear (21) / Idler Gear (30)	0.09 – 0.27 mm = .0035– .0106" (+ 0.3 mm = .012")
Idler Gear (30)	
Bore, Dia	42.038–42.022 mm = 1.6550–1.6543"
Running, clearance	0.010– 0.040 mm = .0004– .0016"
End float	0.20 – 0.33 mm = .008 – .013 "
Backlash Idler Gear / Crankshaft Gear	0.18 – 0.38 mm = .007 – .015 " (+ 0.3 mm = .012")
Idler gear carrier, Dia	35.000–34.989 mm = 1.3779–1.3775
Valve Tappets (16)	
Dia	19.970–19.985 mm = .7865– .7868" (- 0.03 mm = .0012")
Bore in crankcase	19.997–20.030 mm = .7873– .7885" (+ 0.05 mm = .0020")
Effective length	48.100–47.700 mm = 1.8937–1.8779" (- 0.10 mm = .004 ")
Clearance in crankcase	0.012– 0.060 mm = .0004– .0023" (+ 0.08 mm = .003 ")
Push Rods (17)	
Effective length, D-155, D-206 and D-310	177.00–176.50 mm = 6.968–6.949" (- 0.40 mm = .016")
D-179, D-239, DT-239, D-246, D-358, and DT-358	211.50–211.00 mm = 8.326–8.307" (- 0.40 mm = .016")
D-268 and DT-402	217.00–216.50 mm = 8.543–8.524" (- 0.40 mm = .016")
Thrust Plate (20)	
Thickness	7.01– 6.96 mm = .276–.274"
Bore, Dia	45.2 mm = 1.779" (present)
Bore, Dia	44.2 mm = 1.740" (displaced)