Model	Engine	Injection pump Bosch designation	Governor Bosch designation	Delivery pump Bosch designation	Test values[1] MB-sheet edition
Standard version up to 1980					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
Standard version starting 1981					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 8	3.0 m 1st edition
(USA) **1978/1979**		Identification: Green type rating plate			
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22	FP/K 22 MW 8	3.0 g 4th edition
(USA) **1980**					
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22 RW 375/2200 MW 28[2])	FP/K 22 MW 22	3.0 g 4th edition
(USA) **1981**					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
126.120	617.951				
(USA) **starting model year 1982**					
123.133 123.153 123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 g 1st edition
126.120	617.951				

(USA) starting model year 1984 California

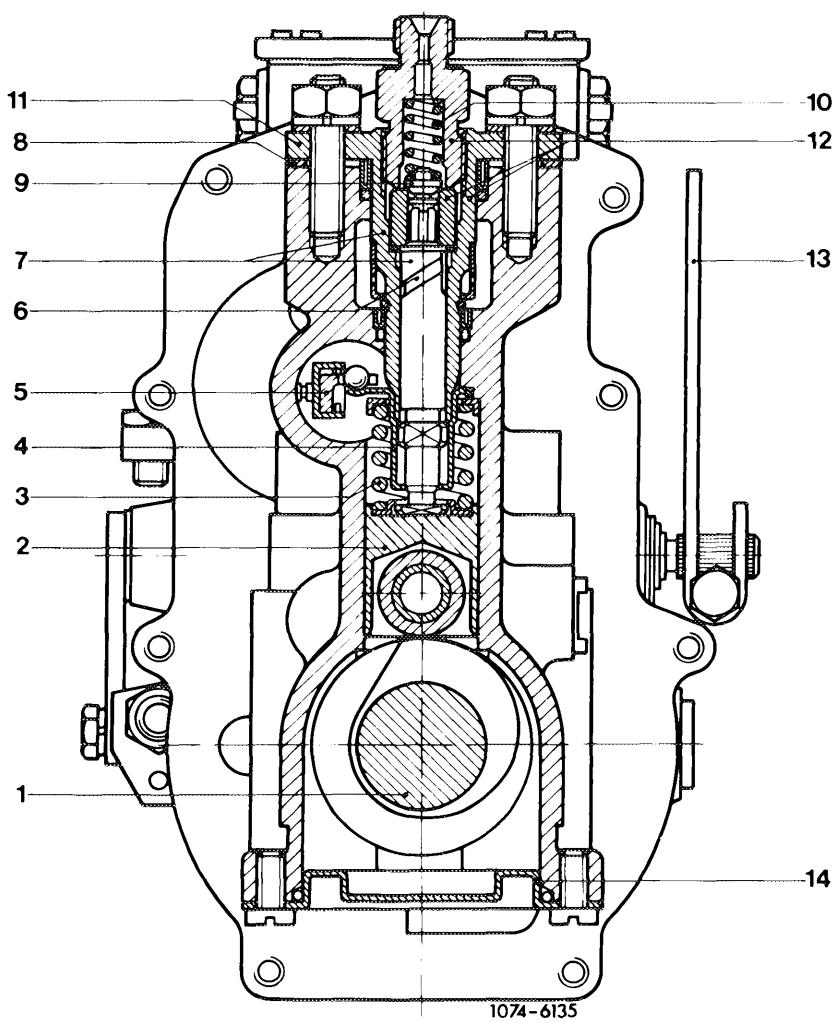
123.133 123.153 617.952 123.193	PES 5 MW 55/320 RS 16–1	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120 617.951				

[1]) Accurate inspection and adjustment of injection pump is possible on an injection pump test bench only. Data sheets for the various pumps are available for workshops where such a test bench is installed.
[2]) Entering production starting February 1980.
[3]) Reference impulse verification (RIV), dynamic checking of injection timing (begin of delivery) possible.

Layout of injection pump

The layout of the injection pump is essentially the same as that of the M injection pump. On the other hand, the element assembly (12) is mounted to injection pump housing by means of holding flange (11).

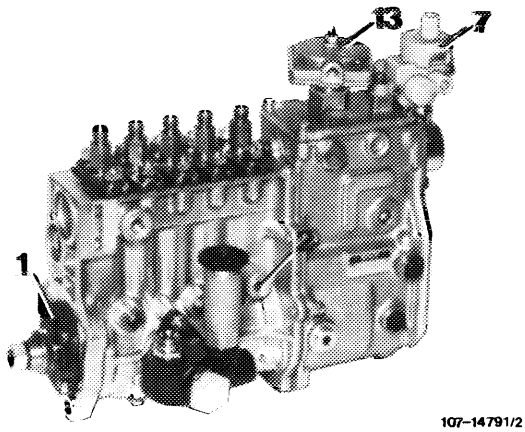
The fastening nuts of the element assembly should never be loosened, since otherwise the basic adjustment of the respective element will be changed and renewed adjustment on the bench will be required.



1 Camshaft
2 Roller tappet
3 Compression spring
4 Control bushing
5 Control rod
6 Control edge
7 Element
8 Adjusting plate
9 Pressure valve
10 Pressure valve spring
11 Holding flange
12 Element assembly
13 Adjusting lever
14 Closing cover

The injection pump is connected to engine oil circuit for lubrication.

The oil inlet (2) for lubrication is at 5th pump element. The oil flows through bores (1) on sealing flange of camshaft again back into crankcase.

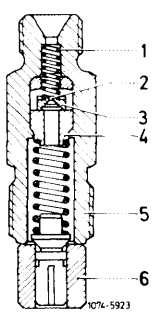


107-14791/2

1 Oil outlet
2 Oil inlet
7 Vacuum control valve
13 ALDA housing

Relief throttle in pipe connection

To reduce hydrocarbons in exhaust gas, relief throttles are installed in pipe connections of injection pump. The relief valve (2) is a platelet valve (3) opening in direction of injection nozzle with an orifice of 0.6 mm dia. The valve seat (4) is riveted into pipe connection. The relief valve permits the fuel to flow in direction of injection nozzle without obstruction. The pressure wave from injection nozzle in direction of injection pump, which is generated upon injection by the after-pumping effect of the nozzle needle when closing, is dampened by the relief throttle. This will prevent the pressure wave from subsequently flowing back to injection nozzle for re-injection. Re-injection will increase hydrocarbons in exhaust gas.



1 Compression spring
2 Relief throttle
3 Platelet valve
4 Valve seat
5 Pipe connection
6 Pressure valve carrier with pressure valve

Layout and operation of RW-governor

The governor is a idle max. speed governor with its regulating spring (11) dimensioned and set in such a manner that the governor is not regulating in partial load range, except for the purpose of torque control (refer to "Throttle control during start and at full load").

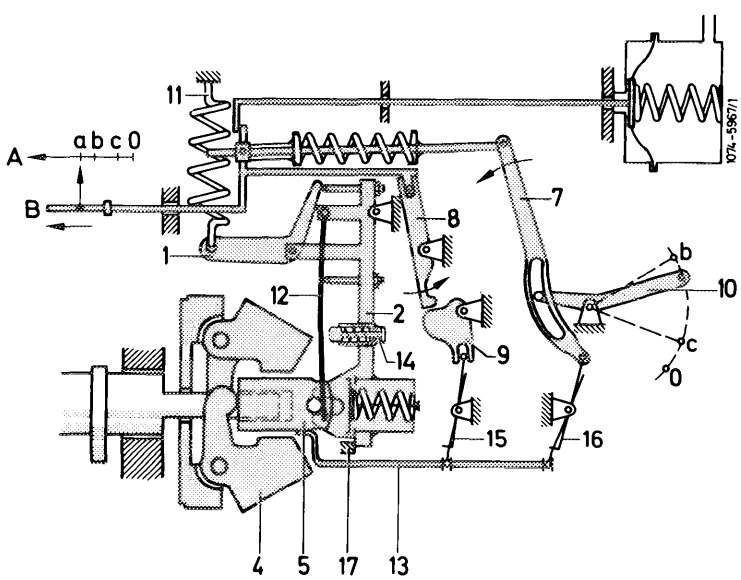
In partial load and full load range, the control rod (B) of the injection pump is operated by means of accelerator pedal only, which is connected to adjusting lever (10) of governor by means of the throttle linkage.

At increasing engine speed, as soon as the centrifugal force is higher than pressure of the regulating springs, the flyweights will move in outward direction. The movement of the flyweights is transmitted to control rod (B) by way of the sliding sleeve (5), the linkage (13) and the slotted lever (7).

As soon as max. speed is attained, the control rod is displaced in direction of stop. As a result, fuel delivery will be reduced and the engine speed will be limited. The procedure is reversed when the ingine speed drops.

Governing procedure during start

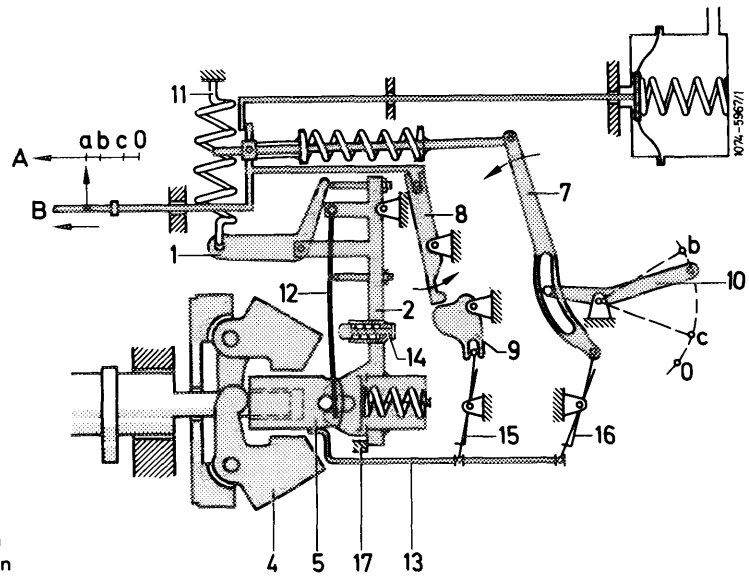
In rest position, the swivel lever (2) is pushed to the left agains stop (17) under influence of regulating spring (11) and bell crank (1). In addition, the fly-weights (4) are forced completely inward into their starting by means of the idle speed spring (12) via sliding sleeve (5).



1	Bell crank	13	Linkage
2	Swivel lever	15	Connecting lever
4	Flyweights	16	Connecting lever
5	Sliding sleeve	17	Stop
7	Slotted lever		
8	Finger	A	Control path
9	Cam	B	Control rod
10	Adjusting lever	a	Starting position
11	Regulating spring	b	Full load position
12	Idle speed spring	c	Idle speed position

When the accelerator pedal or the adjusting lever (10) are operated, the control rod (B) can be moved into starting position (a), since the excess fuel lock com-prising cam (9) and sensor finger (8) is eliminated.

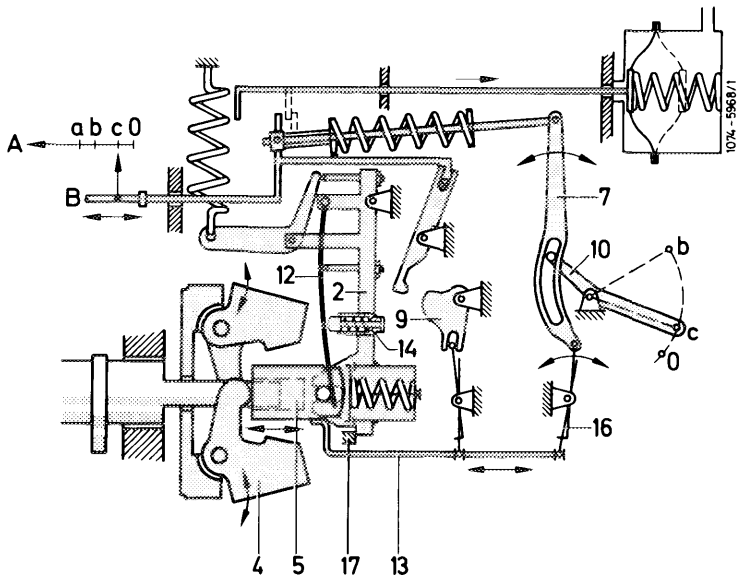
When the engine and thereby the camshaft of the injection pump are starting to rotate, the flyweights (4) will move away from each other. The sliding sleeve (5) will then be moved to the right together with linkage (13) against the spring pressure of the idle speed spring (12). The pin of the sliding sleeve is slidingly located in slot of swivel lever (2). This movement is transmitted to control rod by way of the connecting lever (16) and the slotted lever (7). Finger (8) will be swivelled out of cam (9) by way of the control rod.



1	Bell crank	13	Linkage
2	Swivel lever	15	Connecting lever
4	Flyweights	16	Connecting lever
5	Sliding sleeve	17	Stop
7	Slotted lever		
8	Finger	A	Control path
9	Cam	B	Control rod
10	Adjusting lever	a	Starting position
11	Regulating spring	b	Full load position
12	Idle speed spring	c	Idle speed position

As soon as the speed increases, the sliding sleeve (5) with linkage (13) and control rod (B) are each moving in the same direction, that is, a movement of the sliding sleeve to the right also makes the control rod move to the right. The injected fuel quantity is reduced, the engine speed will go down.

The adjusting lever (10) rests outside against resilient idle speed stop. (This may result in excess pressure against idle speed stop during manual shutoff.) In this position , the constant idle speed is regulated by the flyweights (4) together with the idle speed spring (12).



2	Swivel lever	14	Tickler
4	Flyweights	16	Connecting lever
5	Sliding sleeve	A	Control path
7	Slotted lever	B	Control rod
10	Adjusting lever	a	Starting position
12	Idle speed spring	b	Full load position
13	Linkage	c	Idle speed position

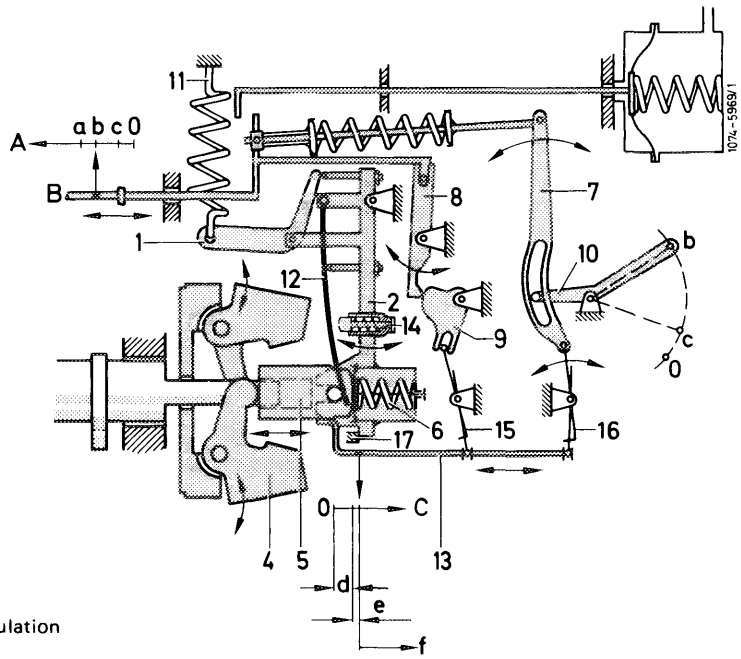
At dropping speed, the flyweights (4) are forced inwards by the spring force of the idle speed spring (12). The sliding sleeve (5) and thereby the linkage (13) will then move to the left. The linkage will automatically shift control rod (B) also to the left under influence of connecting lever (16) and slotted lever (7), which means increased quantity and thereby an increase in speed.

The flyweights are again moving away from each other The sliding sleeve and thereby the control rod are moved to the right (less fuel injected) until the force of the flyweights and the spring force of the idle speed spring (12) are in equilibrium. As a result, an almost constant speed can be maintained also when adding the air-conditioning system, power steering and when engaging a driving position.

To dampen the idle speed, the swivel lever (2) is provided with an auxiliary idle speed spring (tickler 14), which pushes against idle speed spring starting at a given speed and thereby stabilizes the idle speed.

Full load and breakaway speed

In partial load and full load range the control rod (B) of the injection pump is operated by means of accelerator pedal only, which is connected to adjusting lever (10) of governor by way of the throttle linkage.



1	Bell crank	17	Stop
2	Swivel lever	A	Control path
3	Flyweights	B	Control rod
5	Sliding sleeve	C	Sliding sleeve path
6	Compensating spring	a	Starting position
7	Slotted lever	b	Full load position
8	Finger	c	Idle speed position
9	Cam	d	Idle speed path
10	Adjusting lever	e	Compensating path
11	Regulating spring	f	Full load speed regulation
13	Linkage		

In full load position, the adjusting lever (10) rests outside against full load stop, that is, the control rod is at full load, which is the max. delivery quantity the engine can burn free of smoke.

The excess fuel lock comprising finger (8) and cam (9) serves to prevent that excess fuel is injected at full load and low speeds.

Regulation at full load and partial load begins at a given max. speed. The centrifugal force of the flyweights (4) is getting stronger than the pressure of the regulating speed (11) and swivel lever (2) will move from housing stop (17) to the right.

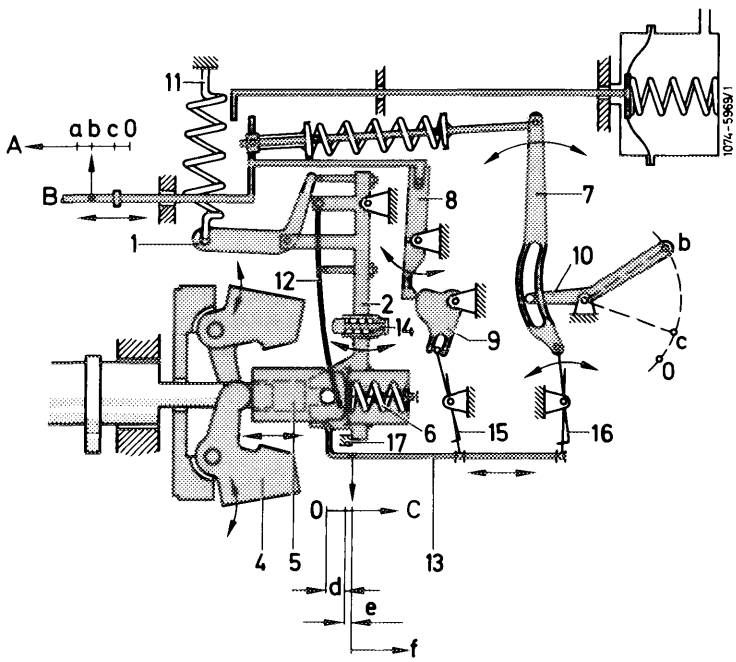
The resulting path of the sliding sleeve moves the control rod via the various transmission elements in direction of stop (0) until a given speed and injection quanty in accordance with the engine load is obtained.

If the engine load is reduced with the adjusting lever position unchanged, the speed will increase up to no load max. speed. The P-degree (proportional degree) can be determined from the difference in speed between breakaway and end of regulation (no load max. speed).

Position between idle and full load speed regulation.

Except for torque control, there is no additional regulation in this range.

Torque control serves the purpose of feeding the engine the proportionally correct amount of injected fuel for each operating point on full load curve.



2	Swivel lever	14	Tickler
4	Flyweights	16	Connecting lever
5	Sliding sleeve	A	Control path
7	Slotted lever	B	Control rod
10	Adjusting lever	a	Starting position
12	Idle speed spring	b	Full load position
13	Linkage	c	Idle speed position

Prior to control the governor is once again in the position shown in illustration. The flyweights have applied excess pressure to idle speed spring (12) and torque control spring (6) via sliding sleeve (5), so that the sliding sleeve (5) rests rigidly against swivel lever (2). When the load on engine is increased, the speed will drop; the torque control spring (6) will slide the torque control pin resting on sliding sleeve (5) in outward direction and the flyweights will come together. The path which can be travelled by the torque control spring is restricted by a stop on torque control pin. The movement of the sleeve will push the control rod forward for a given distance (torque control path) via linkage (13) and slotted lever (7), so that the quantity of the injected fuel and the torque will be increased. The operating range of the torque control is determined by the preload of the torque control spring in torque control capsule and its rigidity.

Absolutely measuring boost pressure stop (ALDA)

The ALDA equipment serves to adapt the injected fuel quantity to the prevailing boost pressure and the respective altitude. As a result, the combustion chambers will always be provided with the correct injected fuel quantity for the pertinent cylinder charge, so that the best possible efficiency during the varying operating conditions will be obtained. The ALDA capsule is connected to the boost air pipe by means of a pressure line.

Enrichment by means of boost pressure (charge-air pressure)

The ALDA equipment comprises 2 aneroid capsules (12), a compression spring (11), a connecting rod (10) and the adjustable guide lever (7). The connecting rod (10) is connected to the control rod (9) by means of the adjustable guide lever (7), lever (3) and slotted lever (4). The increasing boost pressure compresses the aneroid capsules (12) and, supported by compression spring (11), the connecting rod (10) is pulled in direction "a". As a result, the adjustable guide lever (7) will move within its adjusting range in direction "b" and will thereby push control rod (9) in direction "c" via coupling lever (3) and control lever (4). **The injected fuel quantity will be increased.**

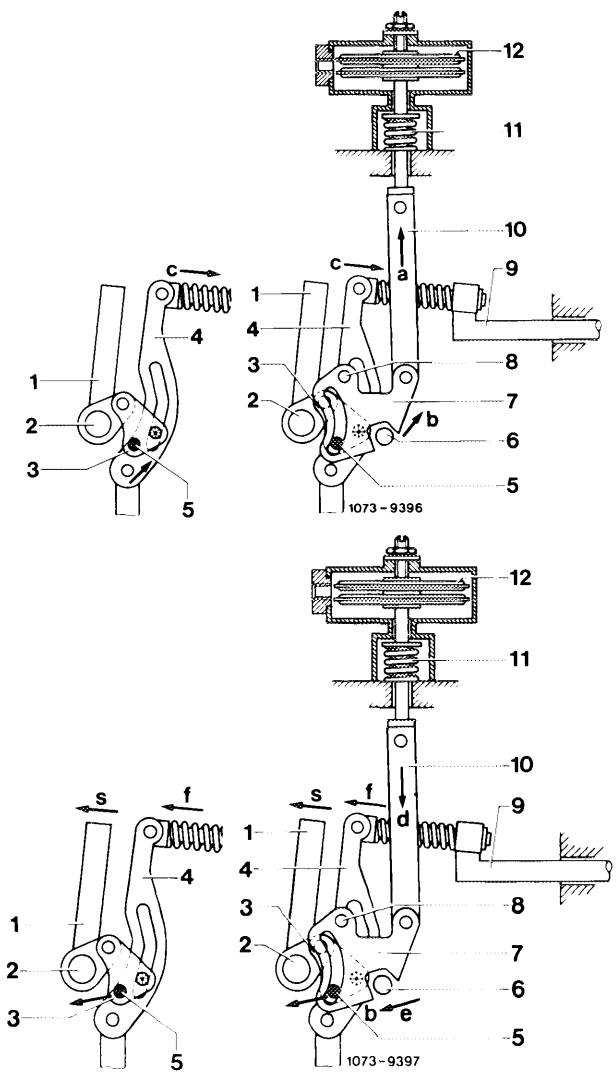
ALDA with control equipment

1 Adjusting lever
2 Adjusting lever shaft
3 Coupling lever
4 Control lever
5 Pin
6 Stop
7 Adjustable guide lever
8 Pivot (adjusting guide lever)
9 Control rod
10 Connecting rod
11 Compression spring
12 Aneroid capsules

Altitude compensation

During altitude operation, the aneroid capsules (12) will expand under influence of the reduced absolute pressure and will push connecting rod (10) in direction "d" against compression spring (11).

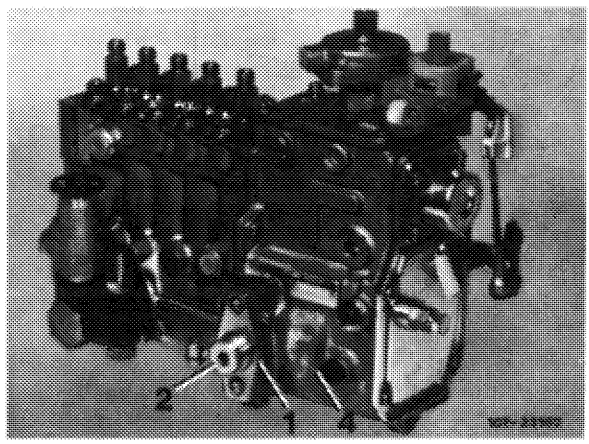
The ALDA adjustable guide lever (7) will automatically move in direction "e" and control rod (9) will consequently move over coupling lever (3) and control lever (4) in direction "f". **The injected fuel quantity will be reduced.**

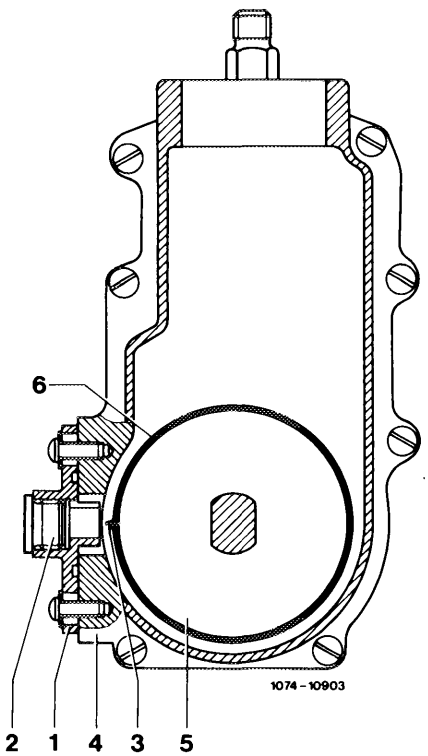


Reference impulse verification "RIV" for checking and adjusting injection timing (begin of delivery)

Instead of the static overflow method used up to now, injection timing (begin of delivery) can now be checked and adjusted with the engine running.

For this purpose, a flange (1) with closing plug (2) has been mounted outside on governor housing, and a lug (3) has been fitted to sheet metal bell (6).





1 Flange
2 Closing plug
3 Lug
4 Governor housing
5 Governor member
6 Sheet metal bell

Operation

Two signals are required to measure the association of the injection pump in relation to engine:

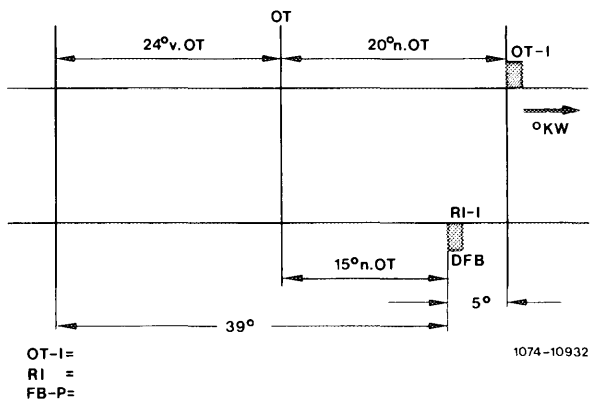
- TDC impulse from crankshaft.
- Regulating impulse from injection pump shaft.

Both impulses are supplied by inductance transmitters. To obtain a measuring signal, the transmitter pins must be moved past the inductance transmitters at a minimum speed (idle speed). A measuring instrument measures the chronological distance of the two pulses and changes the result into an angle value, which is then indicated.

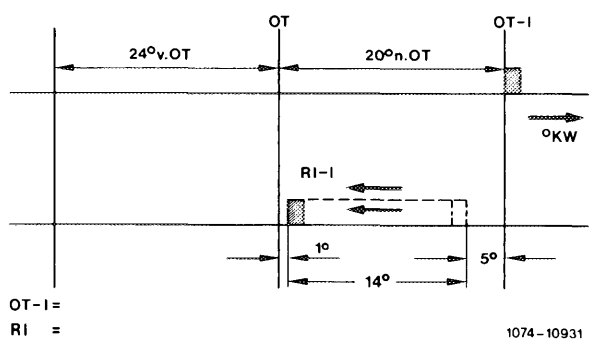
The highest measuring accuracy is attained, if the distance between the measuring impulses is relatively low.

The position of the TDC transmitter is similar to gasoline engine 20° after TDC.

The regulating impulse of the injection pump has been set to 15° after TDC.



OT-I TDC impulse
RI Regulating impulse
DFB Checking injection timing (begin of delivery)



RI Regulating impulse
OT-I TDC impulse

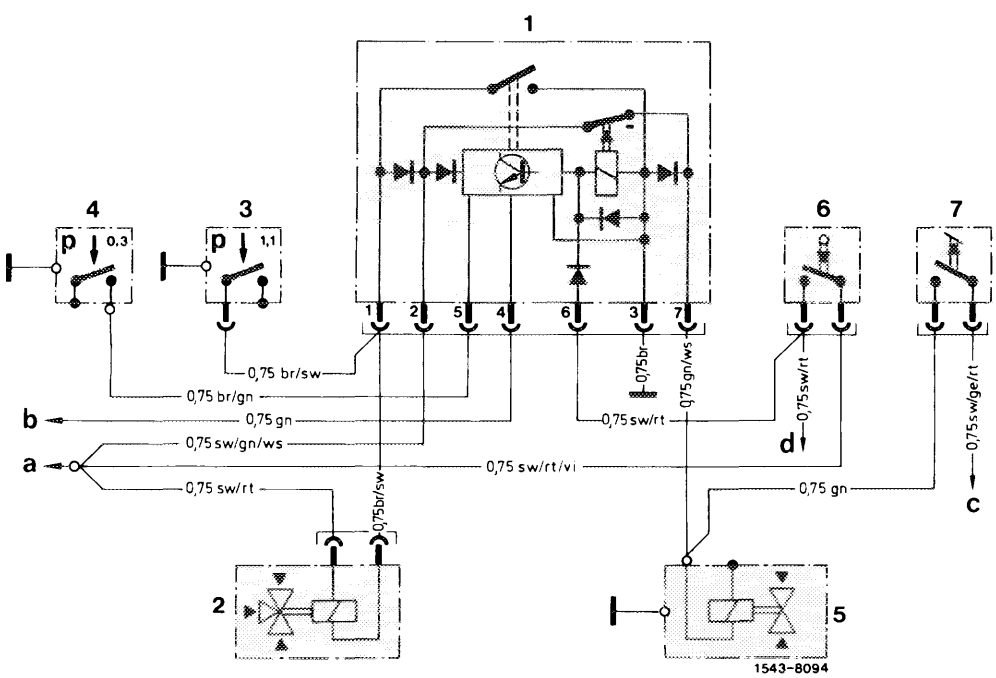
Injection timer

At increasing rpm the injection timer will set the regulating impulse in the direction of advance. The measuring value for injection timing (begin of delivery) is getting smaller and attains approx. 0°–1° at max. adjustment.

Engine-transmission overload protection

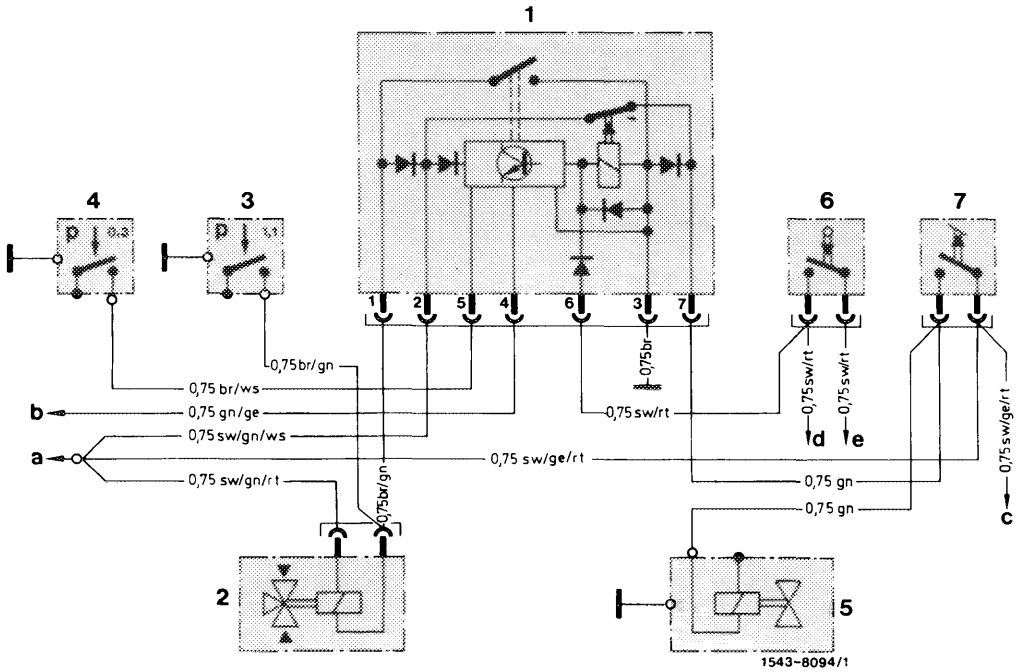
To prevent damage to engine and transmission in the event of faulty operation or during extreme situations the engine-transmission overload protection performs 3 functions:

1. Engine overload protection.
2. Transmission overload protection.
3. Shifting-down automatic transmission into 1st gear when moving off.



Circuit diagram engine-, transmission-overload switch – Model 116.120 (USA) model year 1978–1980

1 Switching unit overload protection
2 Changeover valve
3 Pressure switch boost air pipe
4 Pressure switch transmission
5 Solenoid valve automatic transmission
6 Stop lamp switch
7 Kickdown switch
a To fuse no. 4
b To revolution counter
c To clutch starter lockout switch
d To stop lamps



Circuit diagram engine-transmission overload switch – Model 123.193 standard version

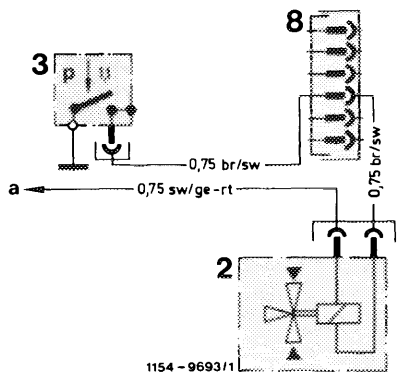
1 Switching unit overload protection
2 Changeover valve
3 Pressure switch boost air pipe
4 Pressure switch transmission
5 Solenoid valve automatic transmission
6 Stop lamp switch
7 Kickdown switch

a To fuse no. 4
b To revolution counter
c To clutch starter lockout switch
d To stop lamp switch

Engine overload protection

Model 123.193
Model 126.120 (USA) starting model year 1981

Starting model year 1981, installation of transmission 722.303 instead of 722.120 has made the transmission overload protection unnecessary. Only an engine overload protection will be installed.

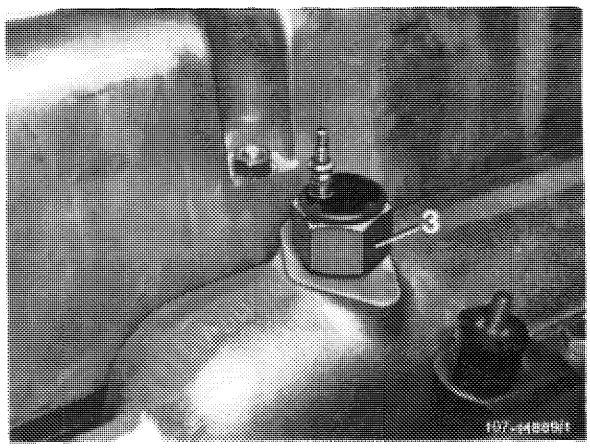


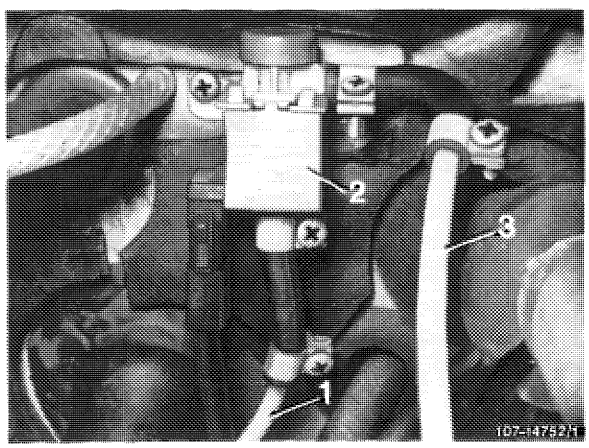
Circuit diagram engine overload protection

2 Changeover valve boost air pipe
3 Pressure switch boost air pipe
a To fuse no. 10 (terminal 15)

Engine overload protection

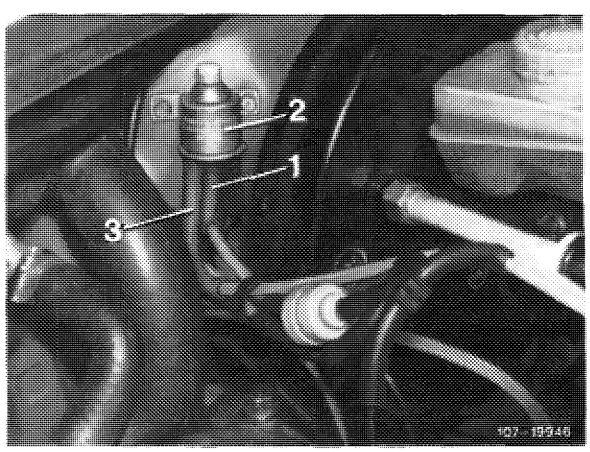
The boost air pipe is provided with a pressure switch (3) At a boost pressure above 1.1 ± 0,15 bar gauge pressure, the pressure switch will close and will connect minus (negative) to changeover valve (2), which is connected to plus (positive) via terminal 15. The changeover valve interrupts the connection boost air pipe to ALDA aneroid capsule on injection pump. The aneroid capsule is connected to atmosphere and the injection fuel quantity is thereby reduced. If the pressure drops to below 1.1 ± 0.15 bar gauge pressure, the pressure switch will again interrupt the minus (negative) connection and will connect the ALDA aneroid capsule again to boost air pipe.



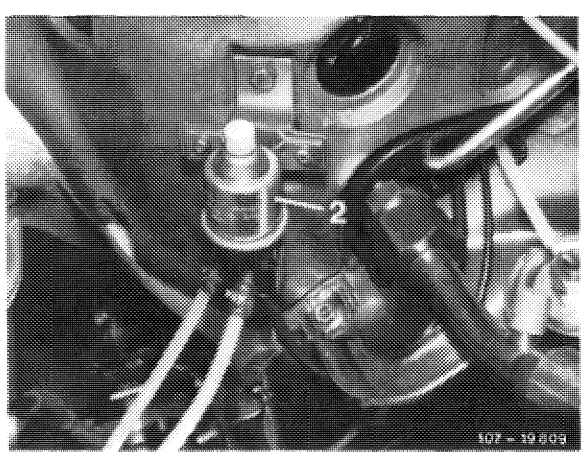


Model 116

1 Pressure line of boost air pipe
2 Changeover valve
3 Pressure line to ALDA capsule



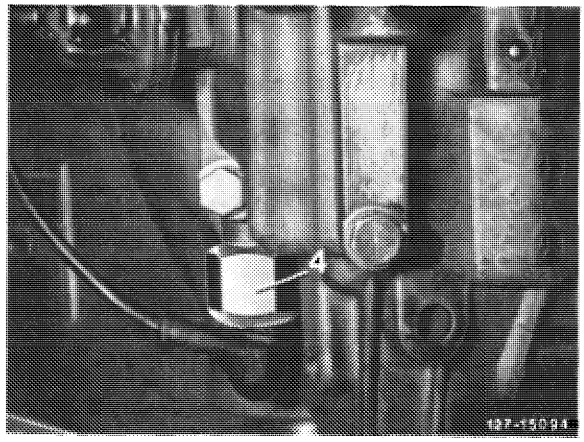
Model 123



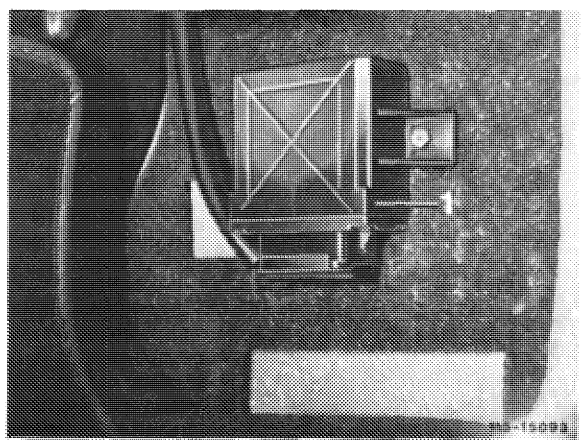
Model 126

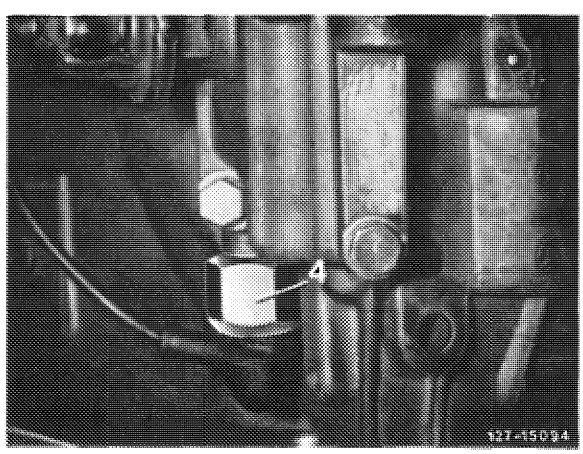
Transmission overload protection

If the pressure switch (4) is subject to a pressure below 0.3 bar gauge pressure (driving speed below approx. 8 km/h) and if the engine speed rises to above approx. 2000/min, e.g.when moving off on a high gradient with a fully loaded vehicle, the transmission may become overloaded by the high torque. A reduction of the injected fuell quantity on injection pump will prevent an engine speed increase obove approx. 2000/min.



The rpm switch in switching unit activates the changeover valve with minus (negative). Since terminal 15 provides a connection to plus (positive), the valve will switch and will provide the pressure line to ALDA capsule on injection pump with ambient pressure. This will reduce the injected fuel quantity, the engine speed will drop below 2000/min (by approx. 100/min). If engine speed drops below approx. 2000/min, the rpm switch in switching unit (1) will interrupt the minus (negative) connection at changeover valve. The valve opens the connection to boost air pipe and will close the connection of pressure line to the atmosphere. The reduction of the injected fuel quantity is cancelled and the engine speed will increase again. This regulating cycle will be repeated until the pressure at switch (4) has attained 0.3 bar gauge pressure. The pressure switch will then close and the overload protection is thereby disconnected.





Job no. of flat rates or standard texts and flat rates data 07–2053.

Testing and adjusting values (USA)

Standard version and

Model	Engine	Idle speed 1/min
116.1	617.95	700–800
123.1		
126.1		

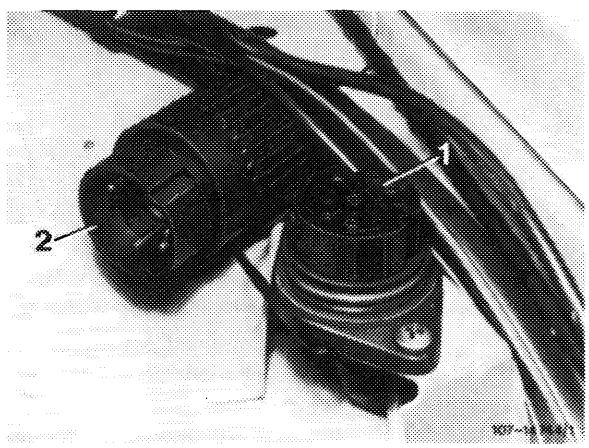
Conventional tester

Digital tester	e.g. Bosch, MOT 001.03

Note

Models 116 and 126 are provided with a revolution counter as standard equipment.

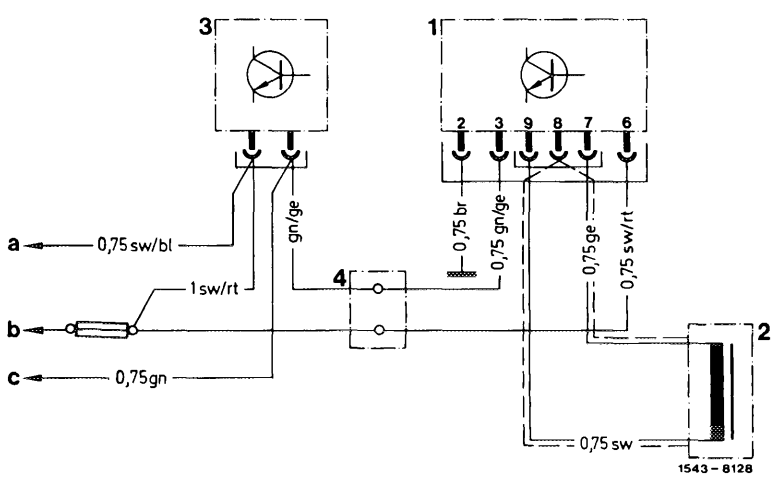
The revolution counter is activated via the transmitter adapter in the diagnostic socket. The adapter for the TDC transmitter clips into the cap on the diagnostic socket.



1 Diagnostic socket
2 TDC transmitter adapter

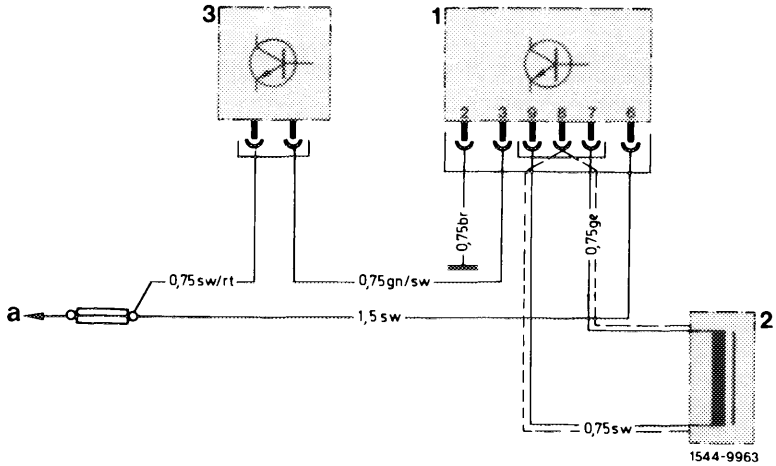
Do not adjust idle speed when engine is too hot, e.g. immediately following a fast drive or after measuring output on output dynamometer.

Model 116
Circuit diagram
Revolution counter



1 Adapter for TDC transmitter
2 TDC transmitter
3 Revolution counter
4 Cable connector
a to warning lamp, brake lining/pad wear indicator
b to terminal 15 (fuse No. 4)
c protection device

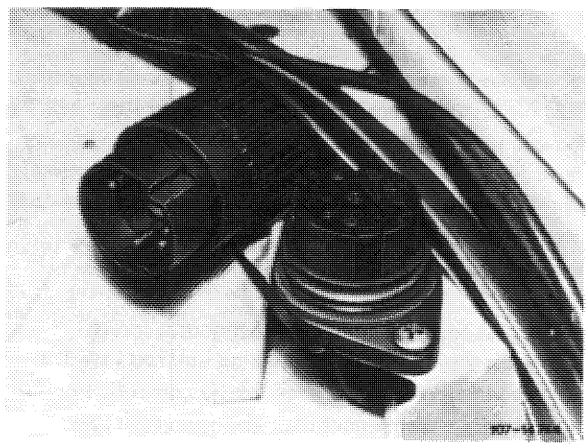
Models 123, 126
Circuit diagram
Revolution counter



1 Adapter for TDC transmitter
2 TDC transmitter
3 Revolution counter
4 Cable connector

a To terminal 15 (fuse no. 12)

Adjustment



1 Switch off air-conditioner or automatic climate control. Move selector lever to position "P".

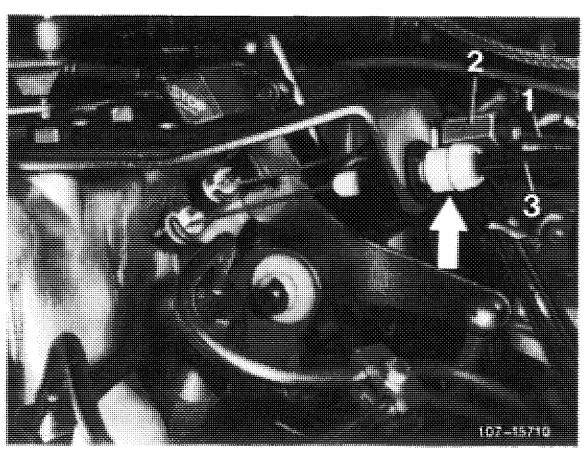
2 Connect digital tester to diagnostic socket.

3 Check control linkage for ease of movement and wear.

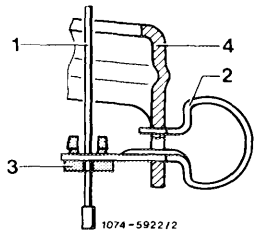
4 Run engine to 60–80 °C coolant temperature.

5 On model 116 up to model year 1979, turn idle speed adjuster completely to the right and check distance between nipple and clip on contour spring and adjust, if required. Nominal dimension ≈ approx. 1.0 mm.

Attention:
Check whether the special form spring is fitted correctly. To do so, turn rotary knob back to left; free movement to point where idle speed rises again must not exceed approx. 1/2 turn. If necessary, adjust at screw (2).



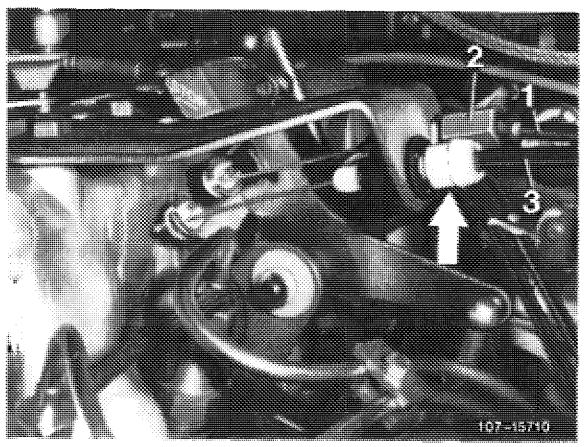
1 Bowden control cable for idle speed adjuster
2 Adjusting screw
3 Bowden wire for cruise control/tempomat



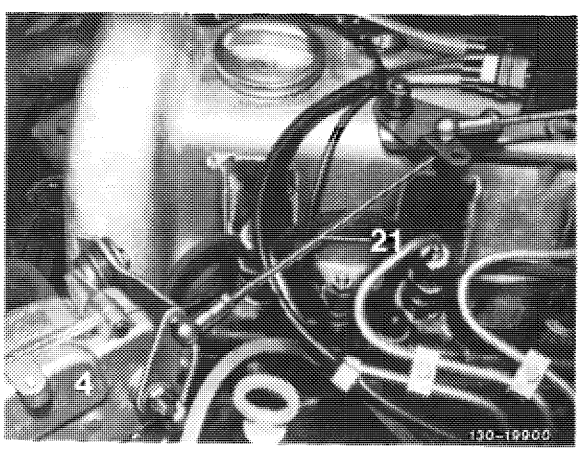
1 Control cable for idle speed correction
2 Special form spring
3 Nipple
4 Bell crank

6 Adjust tempomat (cruise control)

a) Adjust bowden wire for tempomat (cruise control). For his purpose, push shutoff lever up to stop, with bowden wire resting free of tension against regulating lever. Adjust bowden wire with adjusting nut (arrow), if required. Release shuttoff lever (idle speed position). In this position, bowden wire is subject to play.

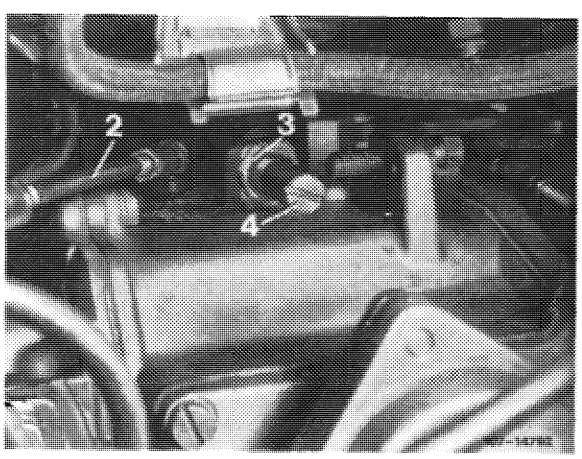


b) Adjust connecting rod for tempomat (cruise control). Check whether adjusting link rests against idle speed stop of tempomat (cruise control). For this purpose, disconnect connecting rod (21) and push lever of adjusting link (4) clockwise against idle speed stop. When attaching connecting rod (21) make sure that the lever of the adjusting link is pushed away from idle speed stop by approx. 1 mm. Adjust connecting rod, if required.



7 Detach connecting rod (2) from bell crank.

8 Check idle speed, loosen counter nut (3), if required, and adjust idle speed by means of idle speed adjusting screw (4) to 700–800/min.



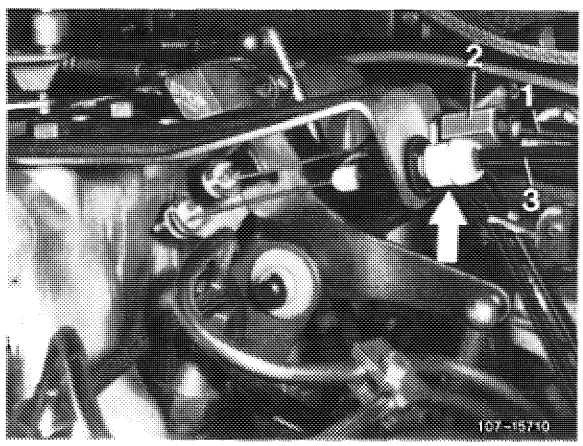
2 Connecting rod to bell crank
3 Lock-nut
4 Idle adjusting screw

9 Attach connecting rod so that it hangs freely. Adjust control linkage if necessary.

10 Move selector lever back to drive position, switch automatic air-conditioner on and turn power steering to full lock, making sure that engine runs smoothly. Adjust speed if necessary.

11 On Model 116 up to model year 1979, accelerate with accelerator pedal while simultaneously turning knob for idle speed adjuster to the left. Speed should now amount to 1000–1100/min. Adjust by means of adjusting screw (2), if required.

Attention:
The idle speed control range will be exceeded if a higher speed is set. The engine speed may then rise to maximum revolutions (at no-load).



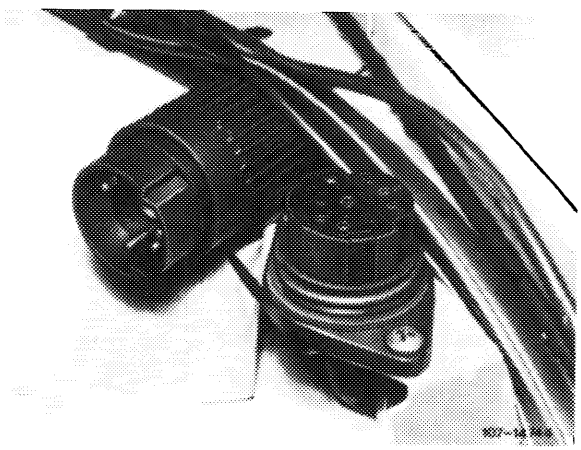
Test value

Maximum speed at no-load (end of control range)	4900—5200/min

Conventional tester

Digital tester	e.g. Bosch, MOT 001.03

Checking



1 Connect digital tester to diagnosis socket.

2 Run engine to 60—80 °C coolant temperature.

3 Slowly accelerate to full throttle at accelerator pedal and read revolution counter. Engine speed should attain 4900—5200/min.

4 If engine fails to reach specified speed, check whether pressure applied to vacuum control unit at injection pump is negative or not, disconnecting hose from control unit for this purpose. If engine still fails to reach specified speed, remove injection pump and adjust maximum speed at no-load on a Bosch injection pump test bench.

07.1–108 Checking injection timing (begin of delivery) with digital tester (RIV method)

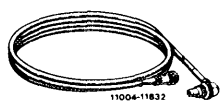
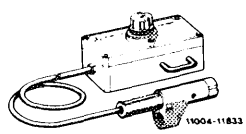
Job no. of flat rates or standard texts and flat rates data 07–8244.

Testing and adjusting value

RI-test value (indirect injection timing)	–15° ± 1° (after TDC)
RI-adjusting value (indirect injection timing)	–15° (after TDC)

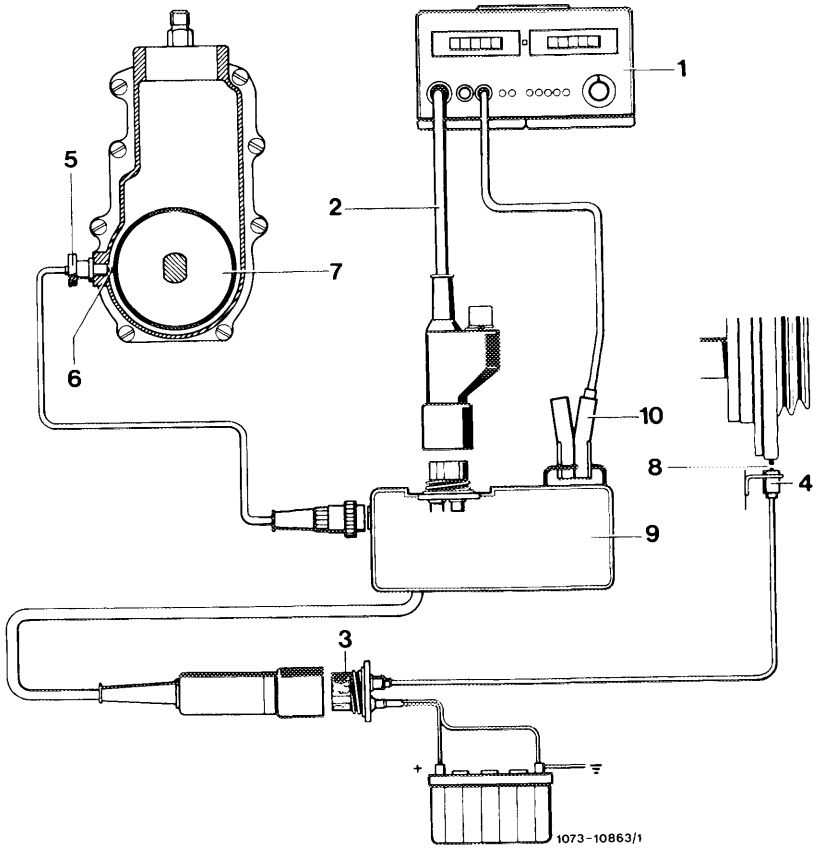
Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

Special tools

RI-transmitter		617 589 10 21 00
RI-adapter (for available digital testers)		617 589 09 21 00

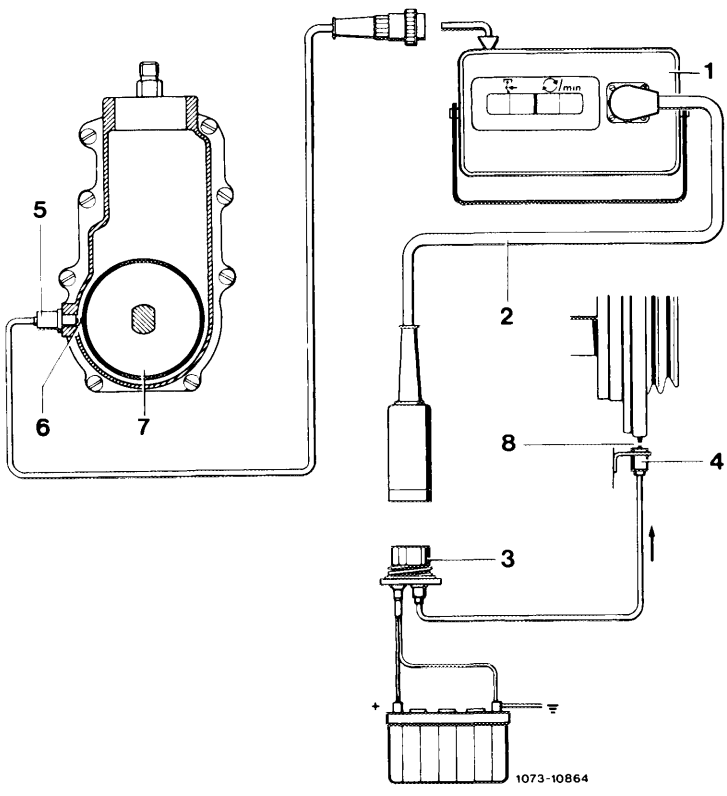
Conventional tester

Digital tester	e.g. Bosch, MOT 001.03



Connection diagram for available ignition-dwell angle testers, e.g. Bosch MOT 001.03, Hartmann & Braun EOMT 3

1 Tester
2 Test cable with plug
3 Diagnosis socket
4 TDC impulse transmitter
5 RI-transmitter
6 RI-transmitter pin
7 Regulator
8 TDC transmitter pin
9 Adapter
10 Trigger clamp



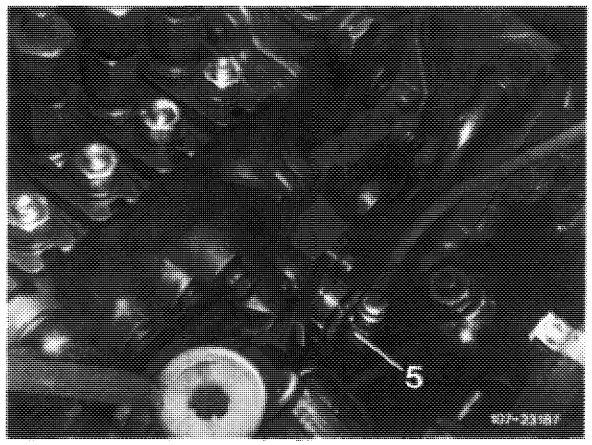
Wiring diagram with diesel tester, e.g. SUN DIT 9000, AVL diesel tester 875, Bosch EDT 019.00

1 Tester
2 Test cable with plug
3 Diagnosis socket
4 TDC impulse transmitter
5 RI-impulse transmitter
6 RI-transmitter pin
7 Regulator (injection pump)
8 TDC transmitter pin

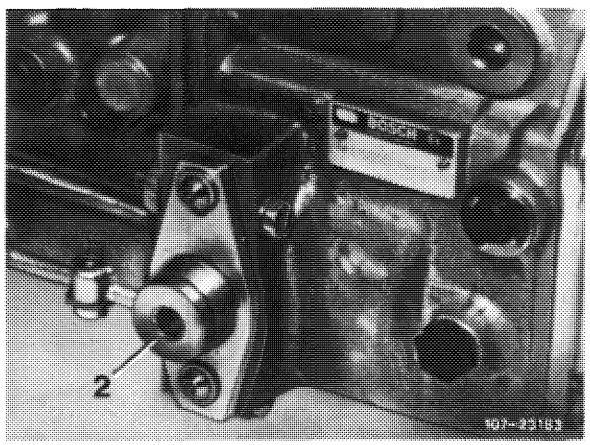
Testing

1 Connect tester according to wiring diagram.

2 Remove closing plug (2) on regulator housing, screw in RI-transmitter (5) and connect electrically with tester.



Attention!
When removing closing plug, approx. 0.2 l of engine oil will flow out. Collect oil.



3 Start engine. Read RI-value (indirect injection timing) and idle speed 700—800/min on tester.

RI-test value: $-15^{\circ} \pm 1^{\circ}$ (after TDC)

Note: If tester indicates values such as:
on Bosch MOT 001.03 -20° or $+147^{\circ}$ or -151
Hartmann & Braun $+67^{\circ}$ or -89°,
the injection pump is more than 5° too much in retard.

For adjustment refer to adjusting injection timing (begin of delivery) (07.1—114).

4 Stop engine.

5 Disconnect tester, remove RI-transmitter and screw in closing plug.

6 Run engine and check for leaks.

7 Check oil level and correct, if required.

07.1–109 Checking injection timing (begin of delivery) (high pressure method)

Job no. of flat rates or standard texts and flat rates data 07–8234.

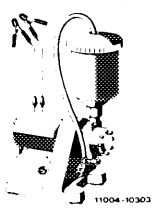
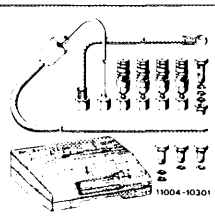
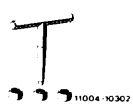
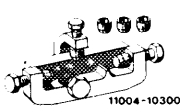
Test values

Injection timing (begin of delivery) before TDC in compression stroke	+24° +1°

Attention!
Push regulating lever of injection pump to full load while measuring and pull vacuum hose from vacuum control unit.

Tightening torque	Nm
Injection lines	25

Special tools

Box end wrench element, open 17 mm, 1/2" square for injection lines	 11004-6359	005 589 68 03 00
Pump unit, complete	 11004-10303	617 589 00 71 00
Connecting members with carrying case	 11004-10301	617 589 00 91 00
Quick lock	 11004-10302	617 589 02 91 00
Closing bracket	 11004-10300	617 589 03 91 00
Drive square 1/2", 80 mm long for rotating engine	 11004-10282	617 589 00 16 00

Conventional tool

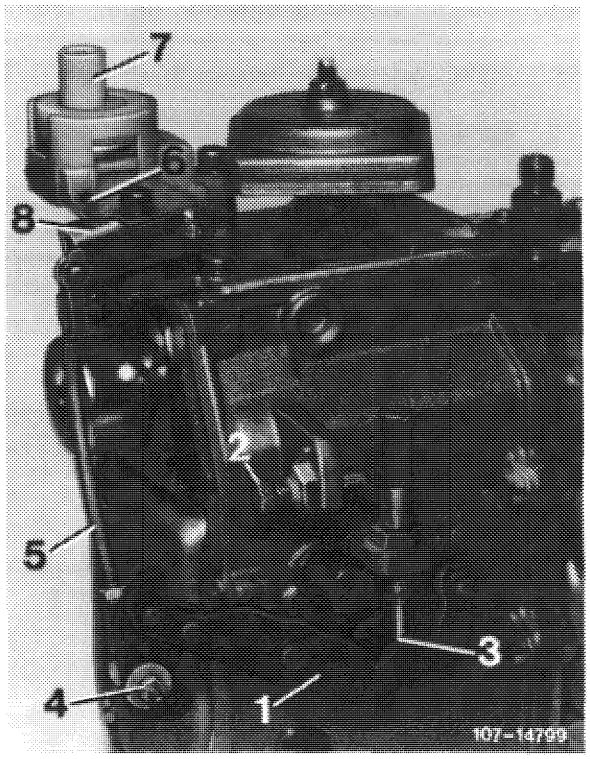
Torque wrench 1/2" square, 15–65 Nm

Checking

1 Clean injection lines in range of coupling nuts on injection pump as well as on fuel filter.

2 Set control rod of injection pump to **full load.** For this purpose, pull control lever (1) to full load stop (2).

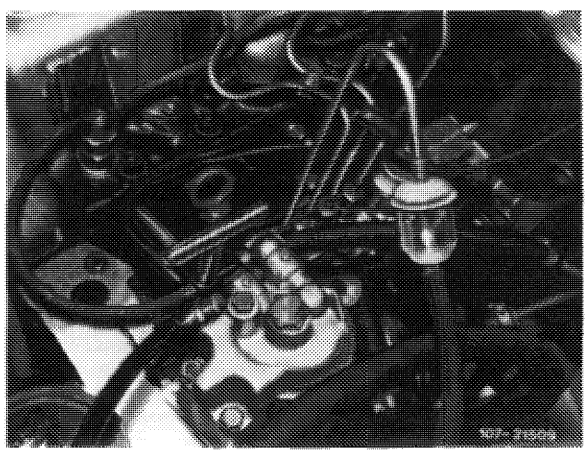
For this purpose, pull vacuum hose from vacuum control unit and lock regulating lever of injection pump to **full load.**



1 Regulating lever
2 Full throttle stop

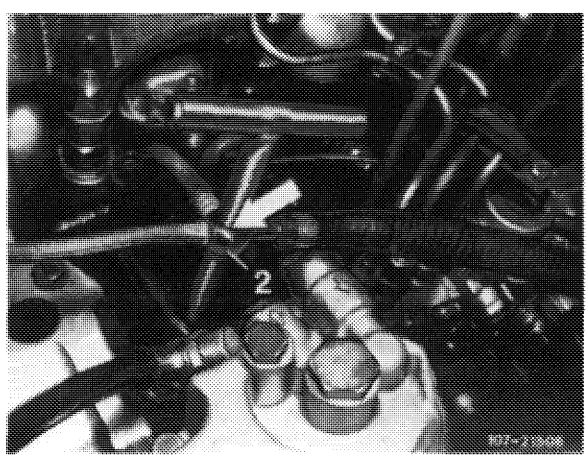
3 Unscrew injection line for cylinder 1.

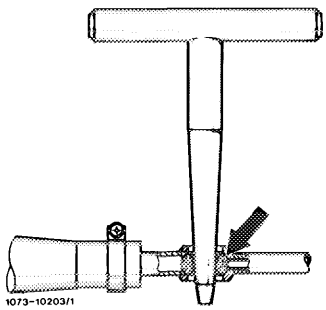
On injection pump, screw on test line with sight glass and install return line to fuel tank of pump unit.



4 Close fuel return line from injection pump to fuel filter.

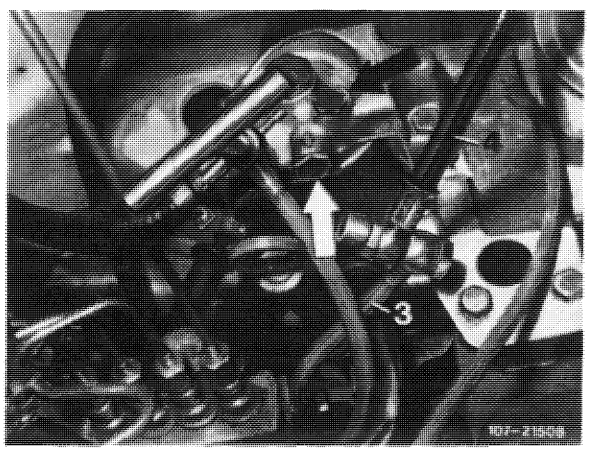
Insert O-ring into ring member (2) of return line and firmly push in quick lock.





Inserting quick lock into fuel return line

5 Connect supply line (3) for injection pump with connecting line (4) of pump unit by means of a double hollow screw. Close connecting holes on fuel filter with closing plugs (arrows).



6 Clamp connecting cable of pump unit to vehicle battery (red terminal positive, black terminal negative).

7 Rotate crankshaft in direction of rotation of engine up to approx. 35° before TDC in compression stroke of first cylinder. Engage pump unit.

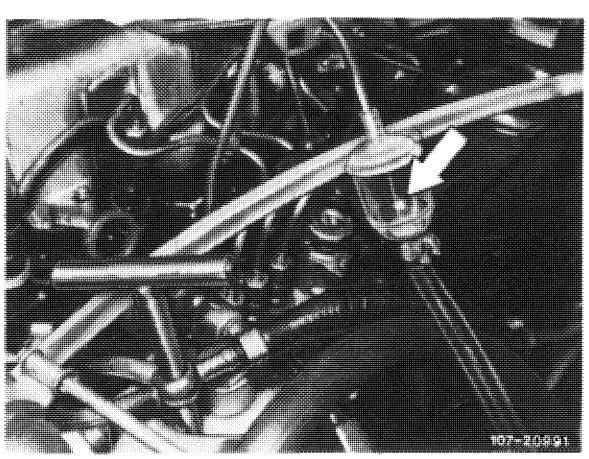
Attention!
Engage pump unit only up to measuring. In the event of a leaking injection nozzle, fuel may enter combustion chamber.

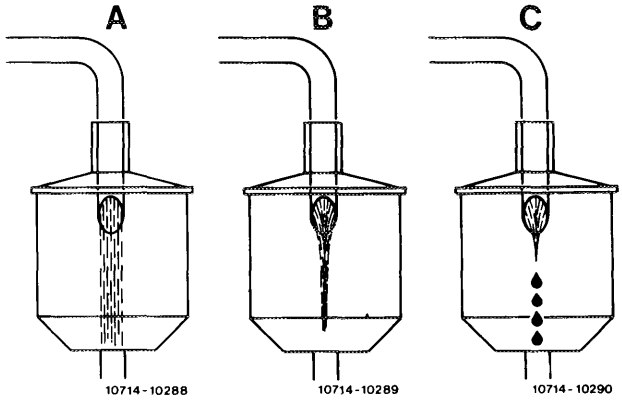
8 Slowly rotate crankshaft in direction of rotation of engine, while watching fuel jet in sight glass.

Delivery begins when the fuel jet changes over into a formation of droplets.

In this position, read begin of delivery on graduated scale on balancing disk.

Nominal value: 24° + 1°

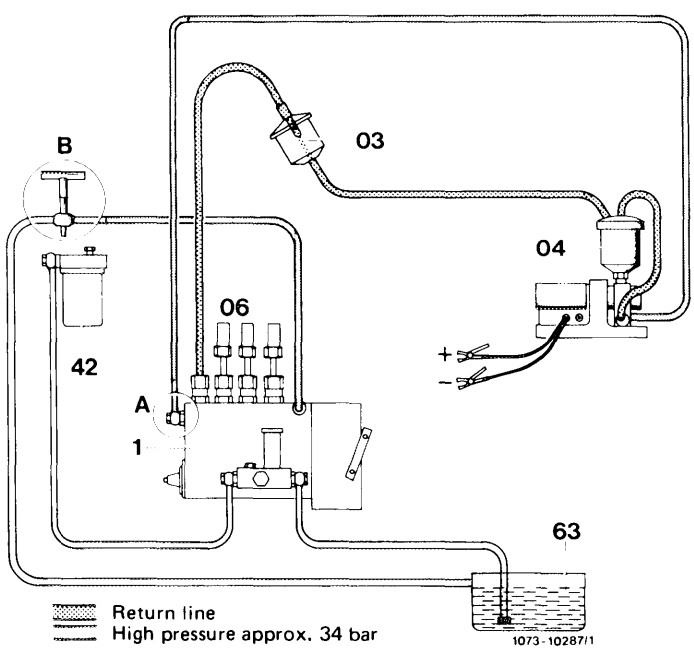




A **Full** fuel jet
B Fuel jet **constricted,** shortly before begin of delivery
C **Formation of droplets,** begin of delivery

9 Disconnect pump unit. Assemble injection system.

10 Ventilate injection system (07.1—140). Run engine and check all connections for leaks.



Connection diagram high pressure overflow method

1 Injection pump
2 Fuel filter
3 Sight glass
4 Pump unit
5 Fuel tank
A Hollow screw, fuel feed from pump unit
B Fuel return line with quick lock or closing bracket closed

07.1–110 Checking injection timing (begin of delivery) (flow pressure method)

Job no. of flat rates or standard texts and flat rates data 07–8228 or 8231.

Test value

Start of delivery before TDC in compression stroke	+24 ± 1°

Attention!
While conducting measurement, move injection pump control lever to full-load stop and disconnect vacuum hose from vacuum control unit.

Tightening torques	Nm
Pipe connection for delivery valves	40–50
Injection lines	25

Special tools

Box wrench socket open, 17 mm, 1/2" drive for injection lines	 11004-6359	000 589 68 03 00
Overflow pipe	 11004-6376	636 589 02 23 00

Conventional tool

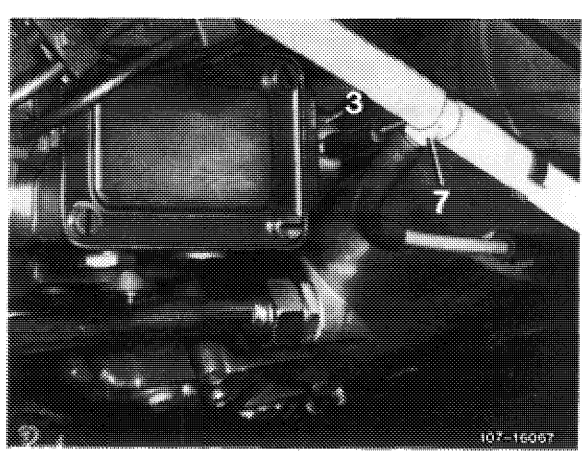
Torque wrench 1/2" drive, 15–65 Nm

Testing

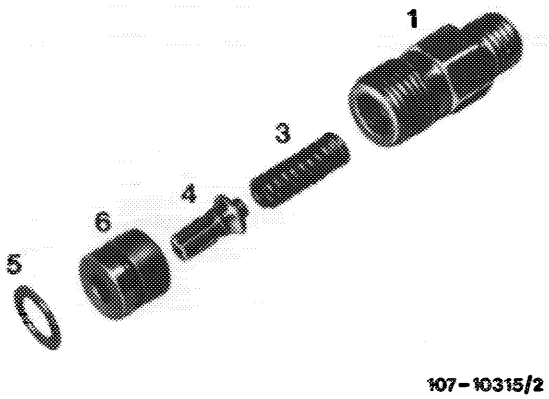
1 Clean injection pump at injection line cap nuts and pipe connections.

2 Pull vacuum line from vacuum control unit.

3 Unscrew injection line of No. 1 cylinder.



4 Unscrew pipe connection (1) of first injection pump element, removing compression spring (3) and delivery valve (4).

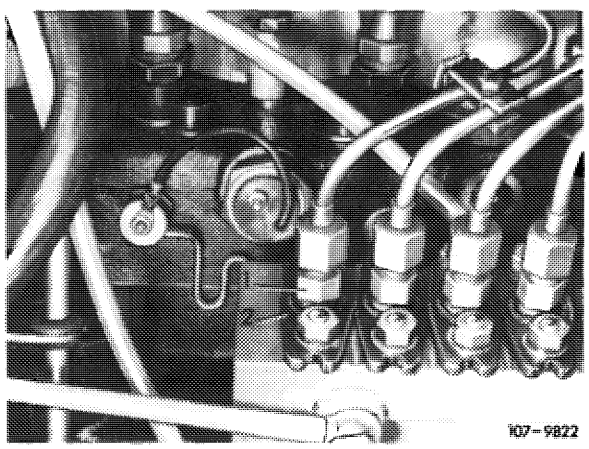


1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve carrier

107-10315/2

Attention:
Do not unscrew assembly (2) because injection pump will otherwise have to be re-adjusted on injection pump test rig.

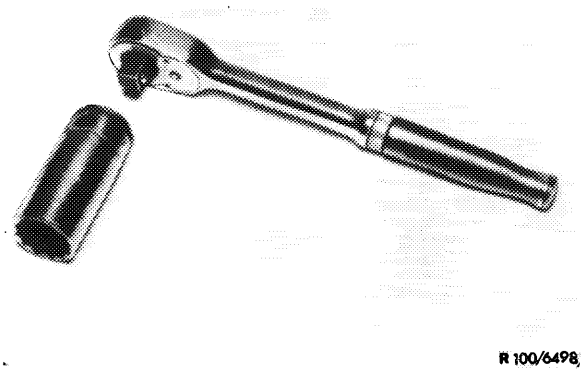
5 Screw pipe connection back in and attach overflow pipe.



1 Pipe connection
2 Element assembly

107-9822

6 Using wrench and socket, turn crankshaft in normal direction until crank angle is just short of start of delivery in compression stroke of first cylinder.



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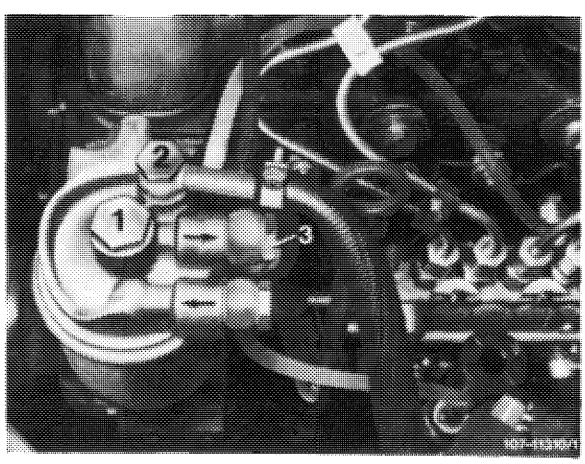
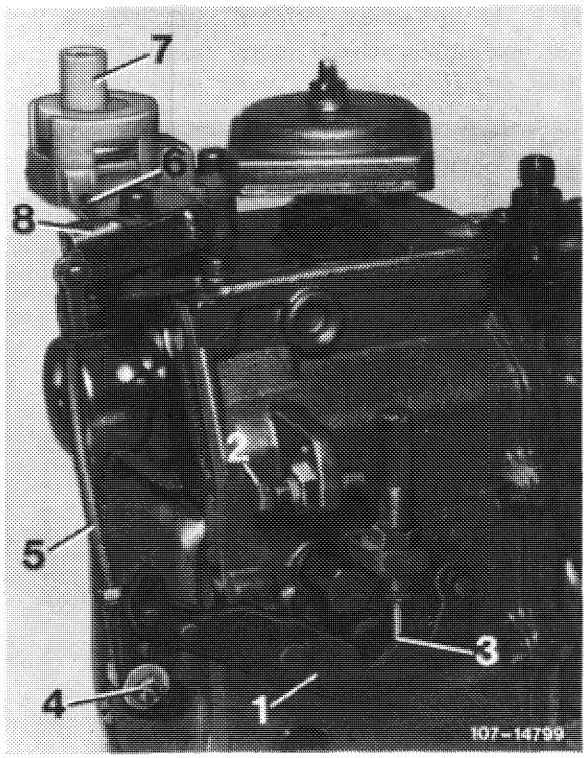
7 Open union screw (2) at fuel filter and fill fuel filter using hand feed pump to make fuel run out of overflow pipe.



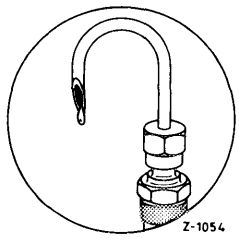
Attention:
While conducting measurement, move injection pump control lever to full load and detach vacuum hose from vacuum control unit.



1 Control lever
2 Full-load stop
3 Idle stop

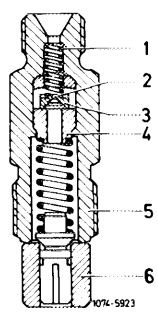
8 Turn crankshaft in direction of rotation until fuel at overflow pipe takes the shape of droplets. Droplet formation: one droplet per second.

Note: On pipe connections with relief throttles (2), no full fuel jet comes out of overflow pipe, but measuring accuracy is not influenced.



9 While maintaining this position, note start of delivery in degrees on balance disk. Adjust start of delivery if necessary (07.1–115).

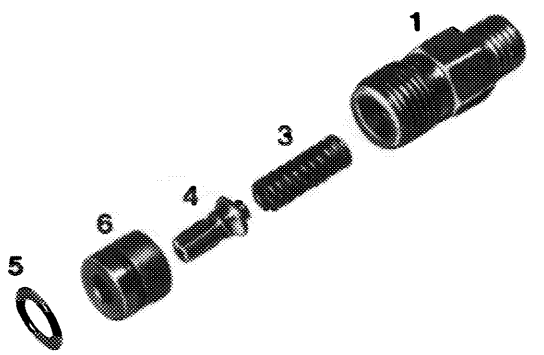
10 Unscrew overflow pipe and pipe connection.



11 Remove delivery valve holder (6), checking whether delivery valve (4) moves freely in holder (6).

12 Insert delivery valve holder (6) with annular groove pointing downward.

Attention:
The copper sealing ring (5) is located beneath the delivery valve holder and need not be exchanged.

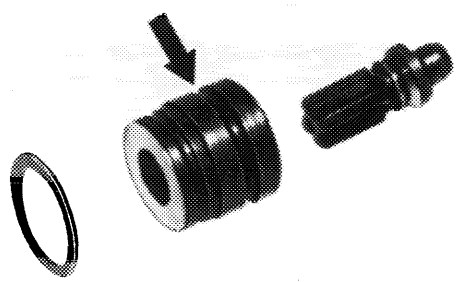


107-10315/2

Up to Bosch production date "248" (August 1982)

1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve carrier

Note: Starting Bosch production date "249" (September 1982) modified delivery valve carriers will be installed. On these carriers, the ring groove must be pointing upwards.



107-25354

Starting Bosch production date "249" (September 1982)

Arrow = modified version with additional ring groove

13 Slightly lubricate threads of pipe connection (1), screw-in and tighten to 40–50 Nm in **one step.**

14 Fit injection line and vent injection system (07.1–140).

15 Run engine and check all connections for leakage. Any pipe connection that is leaking has to be exchanged. In this case, remember to **exchange copper sealing ring beneath delivery valve holder** (07.1–210).

07.1–111 Checking injection timing (begin of delivery) (position indicator RIV method)

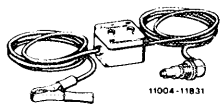
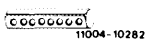
Job no. of flat rates or standard texts and flat rates data 07–8240.

Testing and adjusting value

RI-test value (indirect injection timing)	–15° ± 1.5° (after TDC)
RI-adjusting value (indirect injection timing)	–15° (after TDC)

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

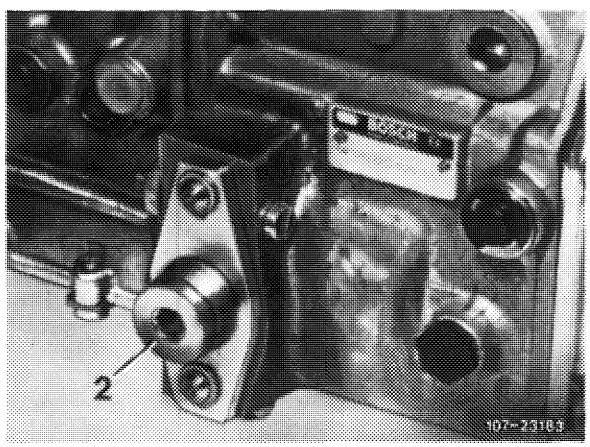
Special tools

Position indicator	 11004-11831	617 589 08 21 00
Drive square 1/2", 80 mm long for rotating engine	 11004-10282	617 589 00 16 00

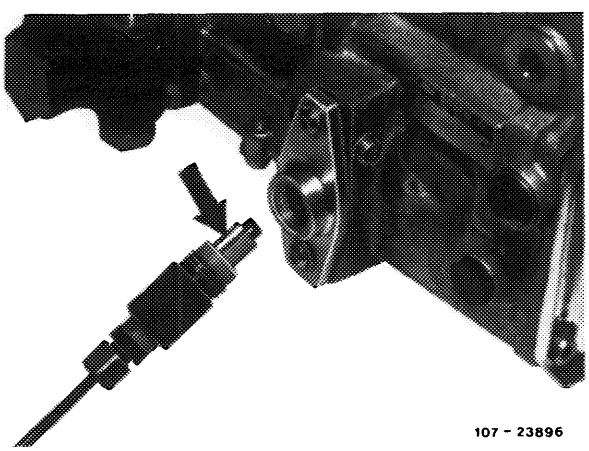
Checking

1 Remove closing plug (2).

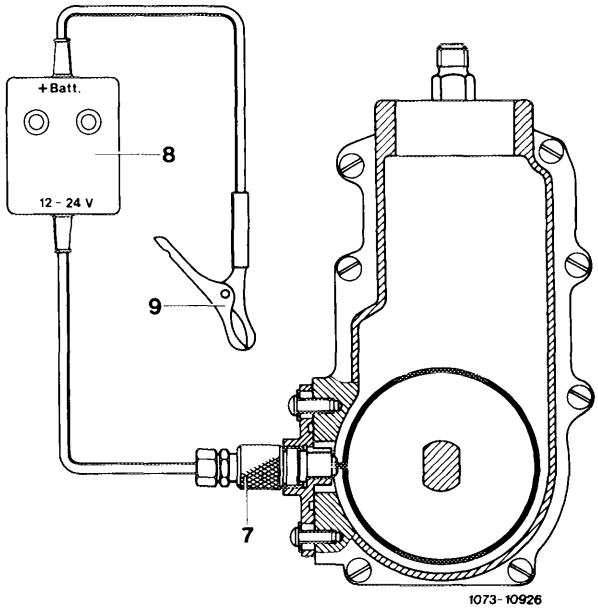
Attention!
When removing closing plug approx. 0.2 l engine oil will flow out. Collect oil.



2 Slip position transmitter into regulator housing. Make sure that the guide pin of position indicator (arrow) is pointing upward. Tighten coupling nut manually.



3 Connect indicating unit according to wiring diagram.

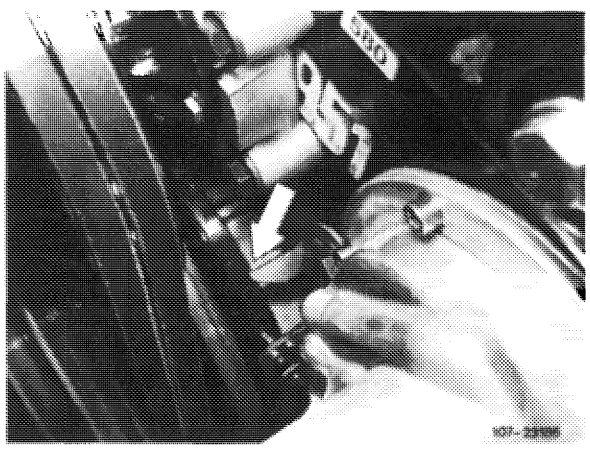


7 Position indicator
8 Indicating unit
9 Battery terminal (battery +)

4 Rotate engine manually (in direction of rotation only) until lamp "A" lights up. Carefully continue rotating engine until **both lamps** are lighting up ("A and B"). In this position, read begin of delivery on graduated scale.

RI-value: -15° after TDC

If only lamp "B" lights up, repeat checkup.



5 Remove position indicator, screw in closing plug.

6 Perform leak test with engine running. Check engine oil level or correct, if required.

07.1–114 Adjusting injection timing (begin of delivery) with digital tester (RIV method) – following checkup

Job no. of flat rates or standard texts and flat rates data 07–8300.

Testing and adjusting value

RI-adjusting value (indirect injection timing)	–15° after TDC

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

Special tool

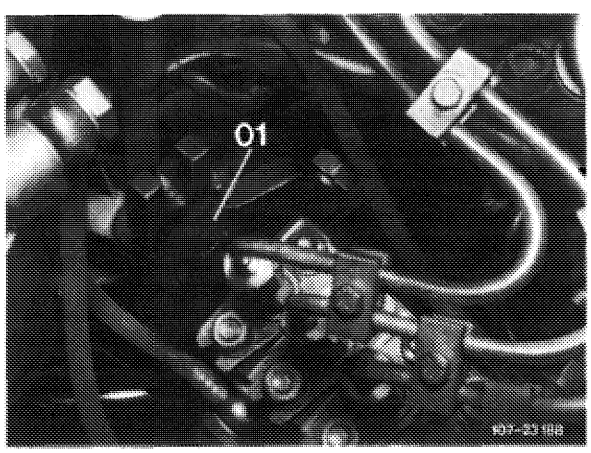
Adjusting device		617 589 07 21 00

Note

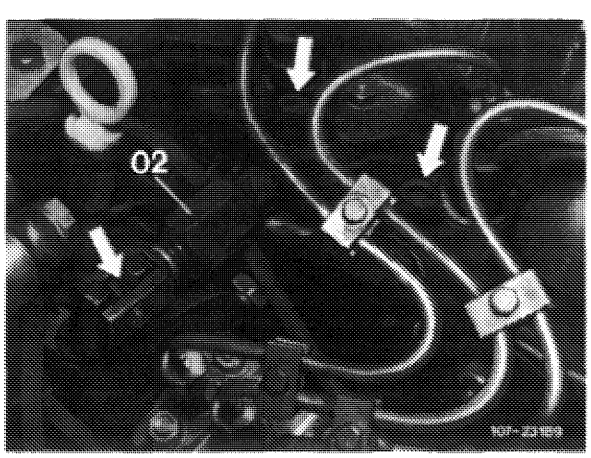
Prior to adjustment, check ignition timing (07.1–108).

Adjusting

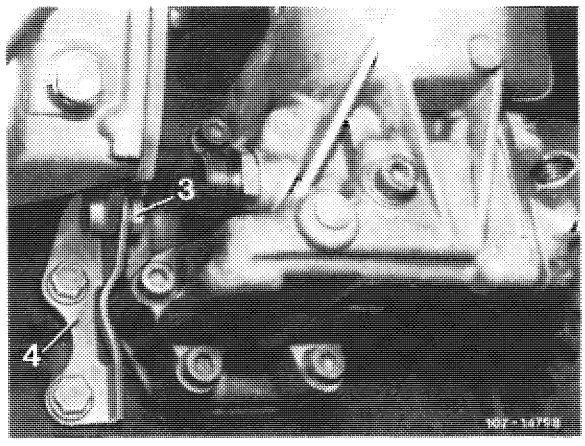
1 Mount holding bracket (01) on injection pump housing.



2 Place adjusting device (02) on cylinder head screws and holding fork (arrows).



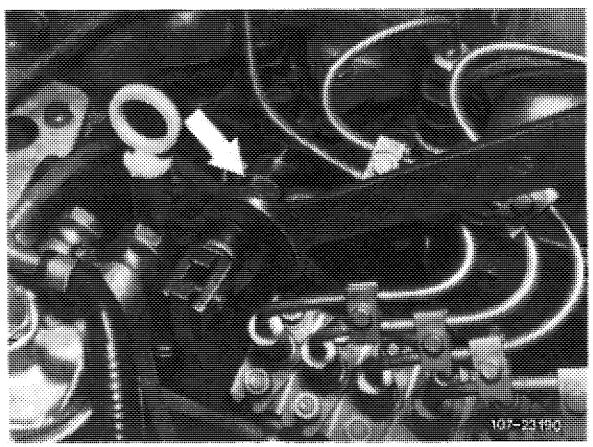
3 Loosen nuts on injection pump flange as well as screws (3) on supporting bracket (4).



3 Screw
4 Supporting bracket

4 Adjust begin of delivery at idle speed by turning hex. head screw (arrow).

RI-value: -15° after TDC.



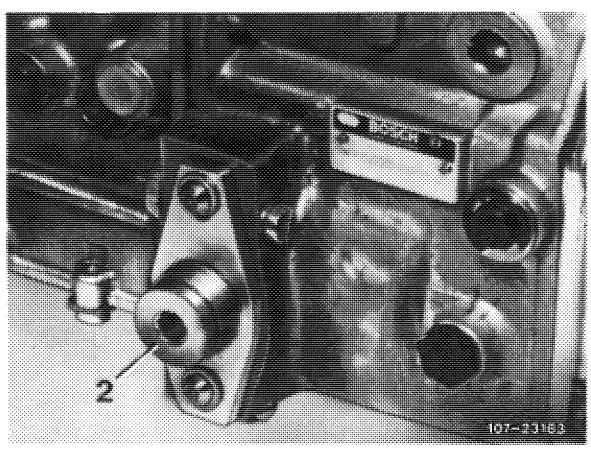
Swivelling direction of injection pump

Toward engine = delivery begins earlier
Away from engine = delivery begins later

5 Tighten nuts and screw for injection pump. Check preset value.

6 Stop engine.

7 Disconnect tester and RI-transmitter. Screw in closing plug (2) and tighten to 30–35 Nm.



8 Run engine and check for leaks.

9 Check oil level and correct, if required.

07.1–115 Adjusting injection timing (begin of delivery) (high pressure method) – following checkup

Job no. of flat rates or standard texts and flat rates data 07–8300.

Special tool

Socket element 13 mm, 3/8" square		000 589 21 07 22

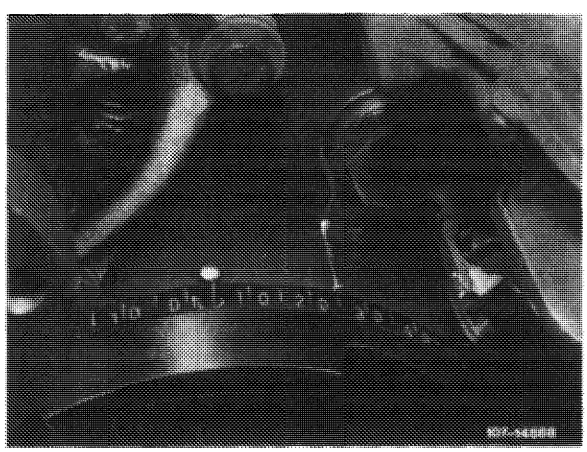
Preparation for checkup

Prior to adjustment, check begin of delivery (07.1–109 or 07.1–110).

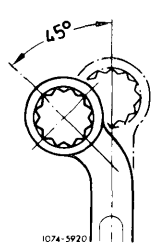
A. Preparing for adjustment

1 Set crankshaft in direction of rotation to 24° + 1° before TDC in compression stroke of first cylinder.

2 Loosen fastening nuts on injection pump flange and nut or screw on supporting bracket.



For loosening and tightening of fastening nuts or screws on supporting bracket, use self-bent box end wrench 13 mm.

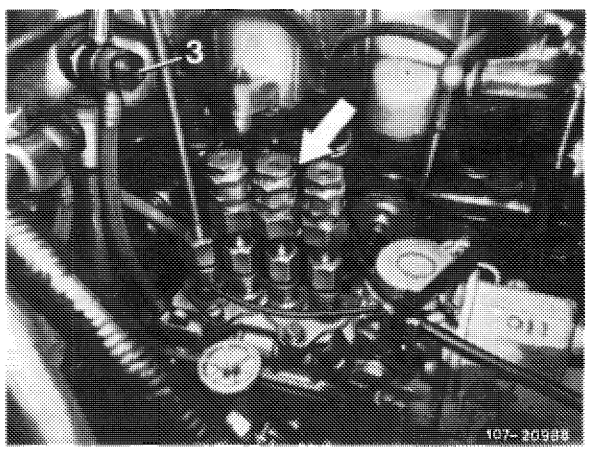


B. Adjustment (high pressure method)

1 Unscrew all injection lines.

2 Screw pressure limiting valves (arrow) on pipe connections of injection pump.

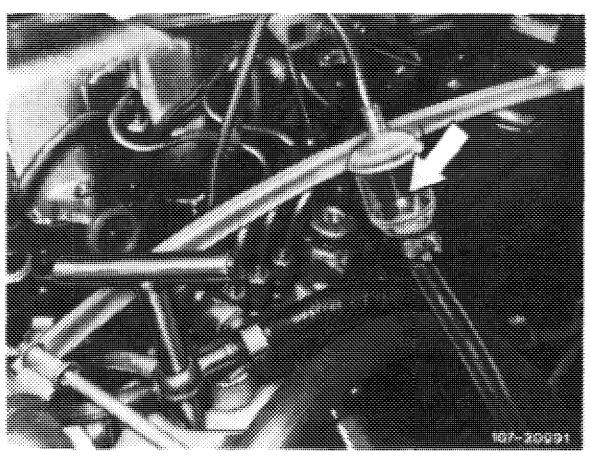
The pressure limiting valves are required to protect the injection pump, e.g. when cranking with starter.



3 Switch on pump unit.

4 Swivel injection pump while watching fuel jet. **Begin of delivery is attained, when the fuel jet changes into a formation of droplets (arrow).**

Nominal value: 24° + 1° before TDC.



Swivel direction of injection pump

Toward engine = advances begin of delivery
Away from engine = retards begin of delivery

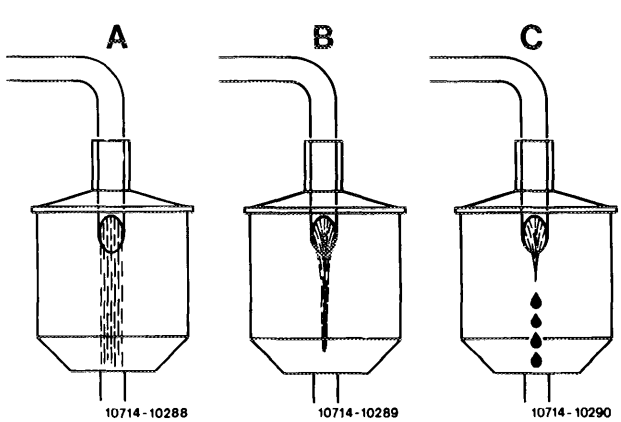
Note: If possibilities for adjustment are insufficient, the injection pump must be changed over.

5 Check begin of delivery once again.

6 Shut off pump unit.

7 Assemble injection system.

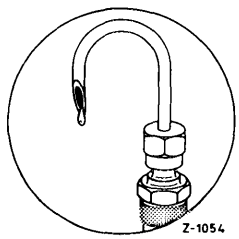
8 Vent injection system (07.1–140). Run engine and check all connections for leaks.



A Fuel jet **full**
B Fuel jet **constricted** prior to begin of delivery
C **Formation of droplets** begin of delivery

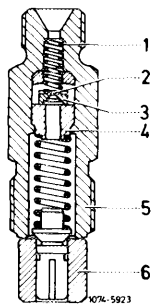
C. Adjustment (low pressure method)

1 Swivel injection pump until fuel changes to droplets at overflow pipe. Formation of droplets: One droplet per second.



Attention!
While measuring, push regulating lever of injection pump to full load and pull vacuum hose from vacuum control unit.

Note: On pipe connections with relief orifice (2), no full fuel jet will come out of overflow pipe. However, measuring accuracy will not be impaired.



Pipe connection MW-injection pump

Swivelling direction

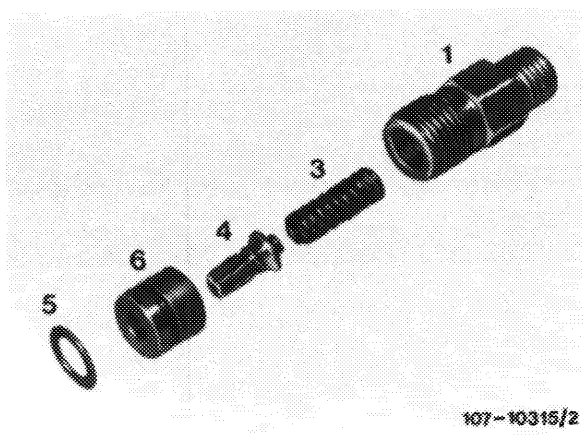
toward engine = advances begin of delivery,
away from engine = retards begin of delivery.

Note: Injection pump will have to be relocated if adjustment is inadequate (07.1–205).

2 Attach injection pump and recheck begin of delivery.
Install damper, adjust (07.1–200).

3 Attach injection pump.

4 Unscrew overflow pipe and pipe connection.



1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve holder

5 Fit pipe connection.

Remove delivery valve holder (6), checking whether delivery valve (4) moves freely in holder (6).

Insert delivery valve holder (6) with annular groove pointing downward.

Attention!
Starting with Bosch production date "249" (September 1982) the annular groove should point upwards.

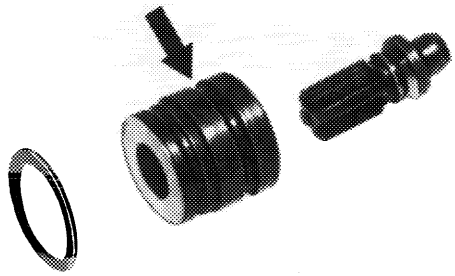
The copper sealing ring is located beneath the delivery valve holder and need not be exchanged.

Smear thread of pipe connection (1) with oil, insert connection and torque to 40–50 Nm in **one step.**

6 Fit injection lines and vent injection system (07.1–140).

7 Check throttle linkage and adjust, if required (30–300).

8 Run engine and check all connections for leakage. Any pipe connection that is leaking has to be exchanged. In this case **exchange copper sealing ring beneath delivery valve holder** (07.1–210).



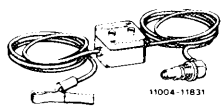
107-25354

07.1–116 Adjusting injection timing (begin of delivery) (position indicator RIV method) – following checkup

Job no. of flat rates or standard texts and flat rates data 07–8300.

Testing and adjusting value	
RI-adjusting value (indirect injection timing)	–15° (after TDC)

Tightening torque	Nm
Closing plug on regulator (measuring point)	30–35

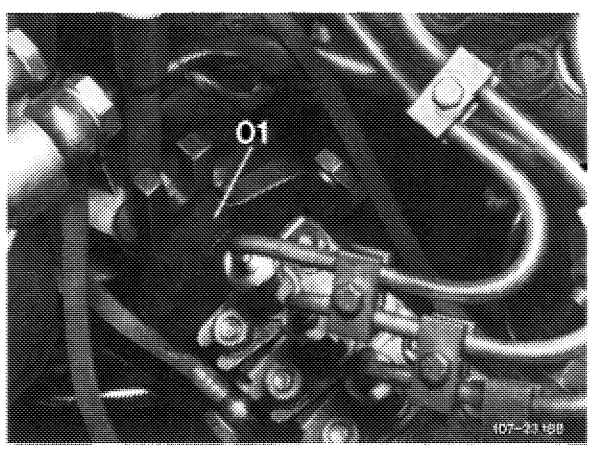
Position indicator		617 589 08 21 00

Note

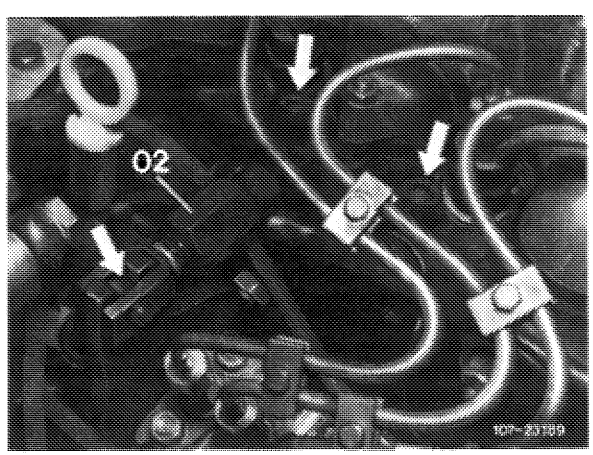
Check begin of delivery prior to adjustment (07.1–111).

Adjusting

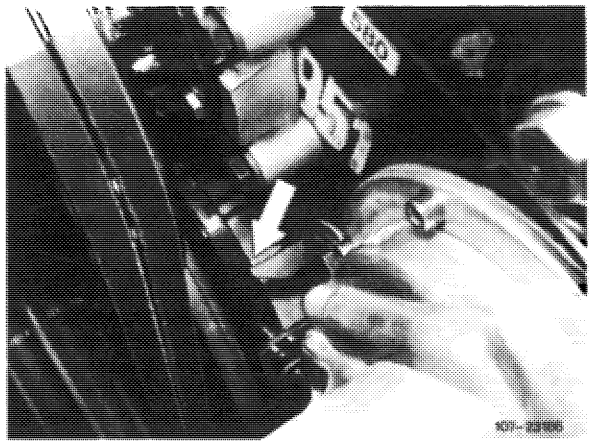
1 Mount holding bracket (01) on injection pump housing.



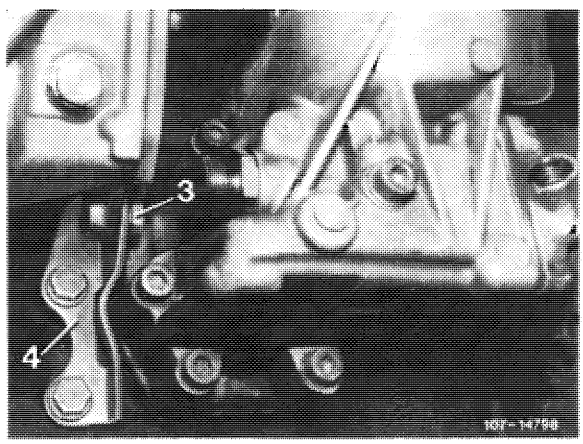
2 Place adjusting device (02) on cylinder head screws and holding fork (arrows).



3 Rotat crankshaft once in direction of rotation and set to -15° after TDC.

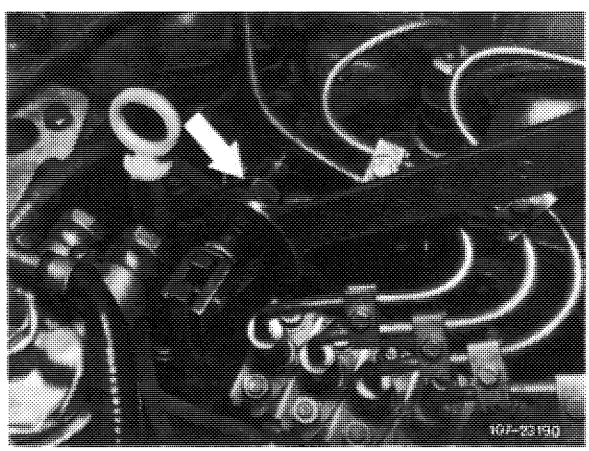


4 Loosen nuts on injection pump flange as well as screws (3) on supporting bracket (4).



3 Screw
4 Supporting bracket

5 Adjust begin of delivery by turning hex. head screw (arrow) (-15° after TDC).



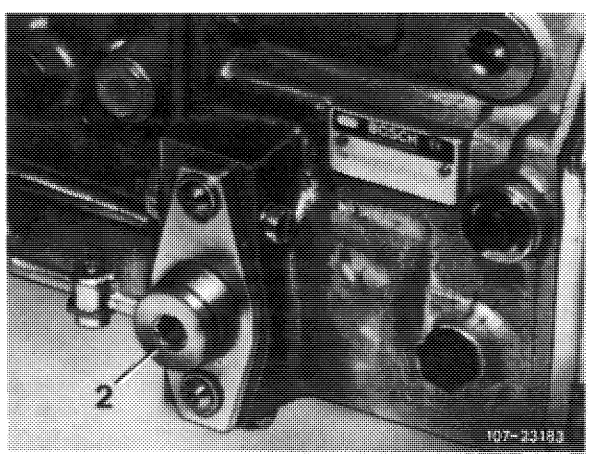
Swivelling direction of injection pump

Toward engine = advances begin of delivery
Away from engine = retards begin of delivery

6 Tighten nuts and screw for injection pump and check preset value.

7 Run engine and check for leaks.

8 Check oil level and correct, if required.



07.1–135 Checking injection nozzles

Job no. of flat rates or standard texts and flat rates data 07–6712.

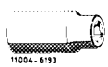
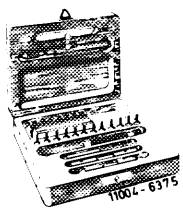
Test values injection nozzles

Bosch designation	Injection pressure in bar positive [1] for new injection nozzles	for used injection nozzles, min.
DNO SD 2400 DNO SD 240[2]) DNO SD 240/[3])	135–143	120

[1]) The difference between any two injection nozzles within one engine must not exceed 5 bar positive.
[2]) Starting production code no. 928 or 041.
[3]) Starting November 1981 with center bore 0.20 mm dia. (formerly 0.15 mm dia.)

Tightening torques	Nm
Injection nozzles, upper and lower parts	70–80

Special tools

Socket 27 mm, 1/2" drive		001 589 65 09 00
Cleaner		000 589 00 68 00

Conventional tools

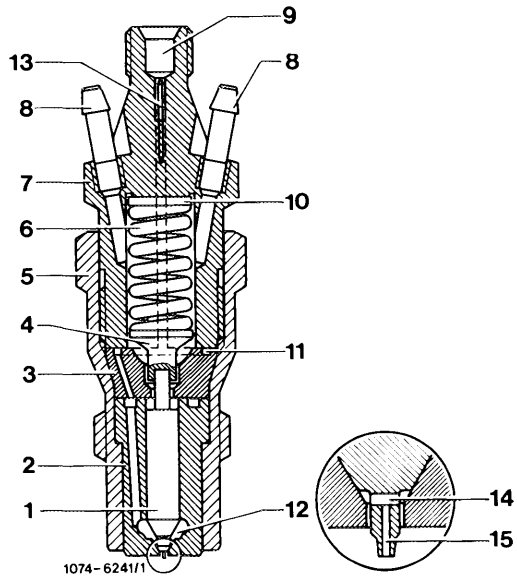
Torque wrench 1/2" drive, 40–130 Nm	
Tester EFEP 60 H	e.g. Bosch, D–7000 Stuttgart Order No. 0 681 200 502
Cleaning needles 0.13 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/3
Cleaning needles 0.18 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/5

Note

For testing always use clean testing oil or filtered diesel fuel. **Be sure never to hold your hand in the jet from an injection nozzle.** For the jet would penetrate your skin, destroy the tissue beneath, enter your bloodstream and possibly give you blood poisoning.

Attention:
Be sure to close the pressure gage tap for checking jet and rattling noise because pressure gage may otherwise be damaged by excessive increase in pressure.

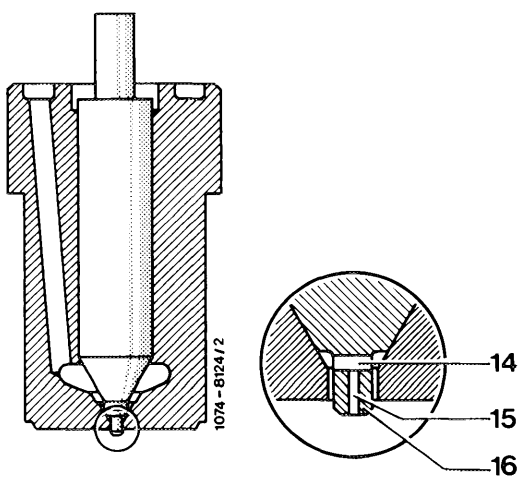
The engine is equipped with a center hole pintle nozzle which is distinguished from the standard pintle by a cross hole and a center hole (14 and 15) in the thrust pin. Moreover, a maintenance-free edge filter (13) is pressed into upper part (7) of the injection nozzle holder.



1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

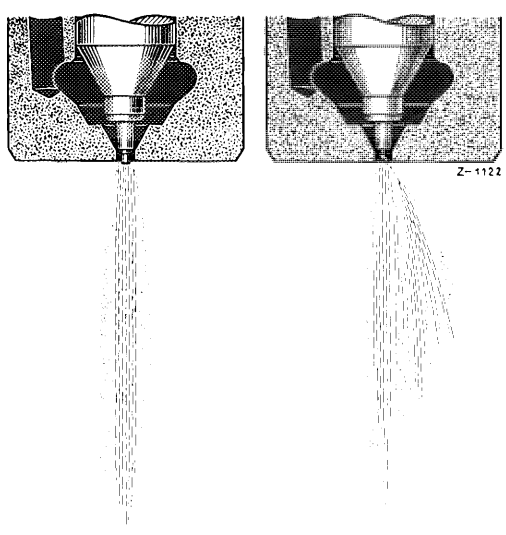
Checking

1 Prior to checking: Check center hole (47) with cleaning needle of 0.18 mm dia. for passage. On nozzles with 0.15 mm ID, check pintle with cleaning needle 0.13 mm dia. for passage.



2 Thoroughly pump injection nozzle 5 times on tester. Then check **buzzing,** actuating hand lever slowly for this purpose (at least 1 stroke per second).

3 **Check jet:** At short, fast partial strokes (at least 2 strokes per second) the jet must be rather closed and break well.

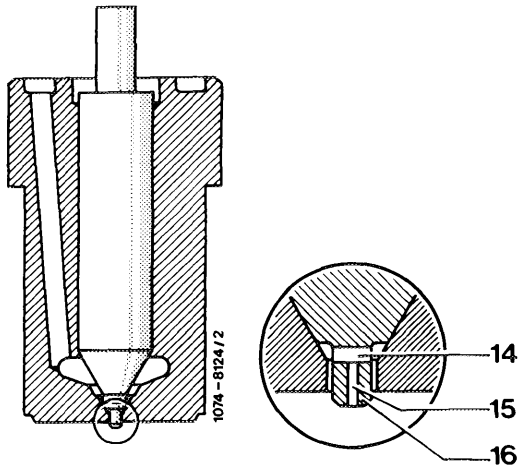


A Jet pattern closed and well atomized
B Jet pattern torn up, too wide and spreading

4 Establish **initial jet** by moving hand lever slowly down (4–6 s/stroke).

A vertical cord-like jet must come out of center hole (15).

Note: On new nozzles, the initial jet is very difficult to produce, for this reason check center hole with cleaning needle 0.18 mm dia. for passage.

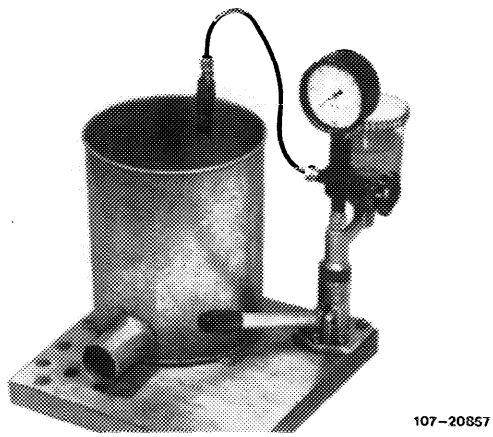


5 **Checking ejection pressure:**

Nominal value: 135–143 bar with new nozzle, at least 120 bar with used nozzle.

At slow downward movement of hand lever (approx. 1 stroke per second) read ejection pressure on pressure gauge.

Shutoff valve must be open for checking.



07.1–137 Disassembly, cleaning, assembly and adjustment of injection nozzles

Job no. of flat rates or standard texts and flat rates data 07-6750 or 6752.

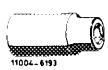
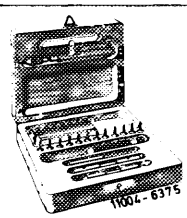
Testing data, injection nozzles

Bosch designation	Injection pressure in bar positive [1] for new injection nozzles	for old injection nozzles, min.
DNO SD 240[2] DNO SD 2400 DNO SD 240/[3]	135–143	120

[1]) The difference between any two injection nozzles within one engine must not exceed 5 bar positive.
[2]) Starting production code no. 928 or 041.
[3]) Starting November 1981 with center hole 0.20 mm dia. (formerly 0.15 mm dia.)

Tightening torques	Nm
Injection nozzles, upper and lower parts	70–80

Special tools

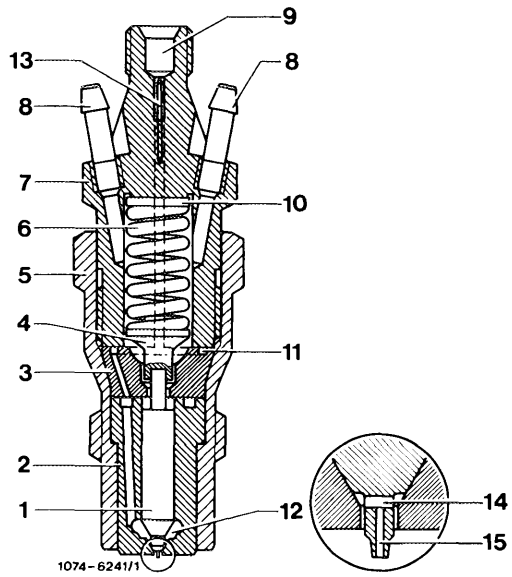
Socket 27 mm, 1/2" drive		001 589 65 09 00
Cleaner		000 589 00 68 00

Conventional tools

Torque wrench 1/2" drive, 40–130 Nm	
Tester EFEP 60 H	e.g. Bosch, D–7000 Stuttgart, Order No. 0 681 200 502
Cleaning needles 0.13 mm dia.	e.g. Bosch, D–7000 Stuttgart, Order No. KDEP 2900/3
Cleaning needles 0.18 mm dia.	e.g. Bosch, D–7000 Stuttgart Order No. KDEP 2900/5

Note

The engine is equipped with a center hole pintle nozzle which is distinguished from the standard pintle by a cross hole and a center hole (14 and 15) in the thrust pin. Moreover, a maintenance-free edge filter (13) is pressed into upper part (7) of the injection nozzle holder.

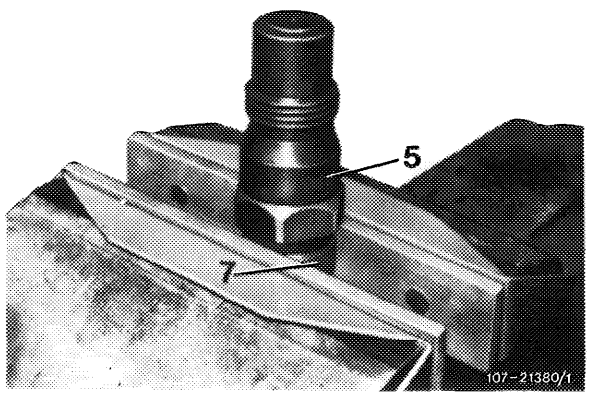


1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

Disassembly

1 Clamp upper part (7) of injection holder in vise so that leak-off connections cannot be damaged.

2 Using socket, release and unscrew lower part (5) of injection nozzle holder.



5 Injection nozzle holder, lower part
7 Injection nozzle holder, upper part

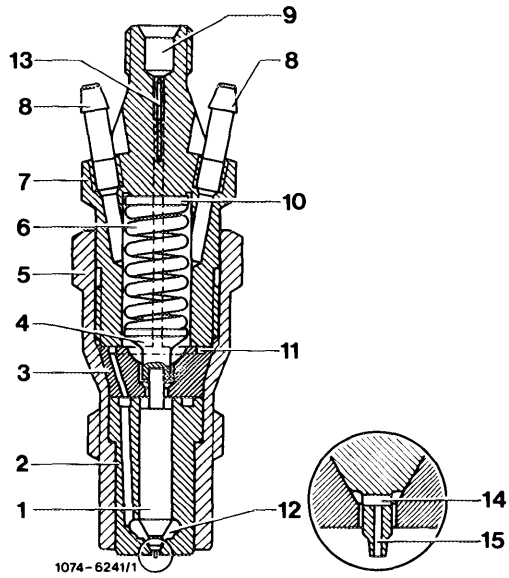
3 Remove steel shim (10), compression spring (6), thrust pin (4), nozzle holder insert (3) and nozzle body (2) together with needle valve (1).

Attention:
When disassembling nozzle, be sure to keep nozzle body, needle valve and all other parts in correct order.

Cleaning

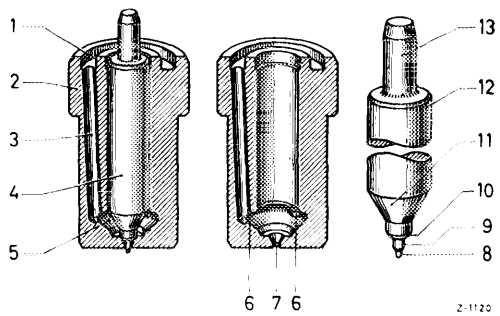
4 Using brass brush, remove carbon deposits from end face of nozzle body (2), chiefly around nozzle orifice.

Using surface plate, check nozzle holder insert (3) and nozzle body (2) for truth at both ends.



1 Needle valve
2 Nozzle body
3 Nozzle holder insert
4 Thrust pin
5 Injection nozzle holder, lower part
6 Compression spring
7 Injection nozzle holder, upper part
8 Leak-off connection
9 Fuel inlet
10 Steel shim
11 Annular groove and inlet ports
12 Pressure chamber in nozzle body
13 Edge filter
14 Cross hole
15 Center hole

5 Clean pressure chamber (5) in nozzle body using annular groove scraper.



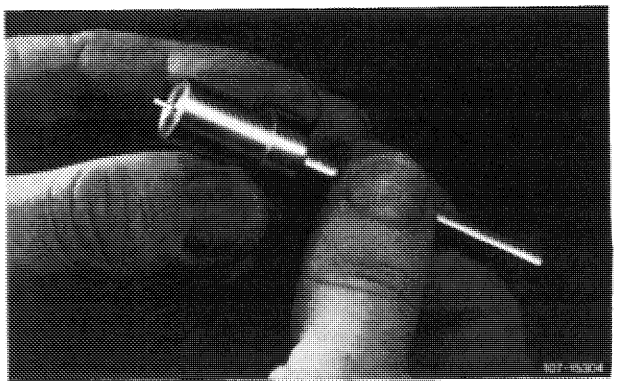
1 Annular groove
2 Nozzle body
3 Inlet port
4 Needle valve
5 Pressure chamber
6 Orifice of inlet ports in pressure chamber
7 Nozzle orifice
8 Injection pin
9 Throttle pin
10 Needle seat
11 Thrust shoulder
12 Needle stem
13 Thrust pin

6 Clean nozzle needle seat in nozzle body with cleaning cutter. This job should be given special care, since usability of a nozzle depends to a high degree on a good nozzle needle seat.

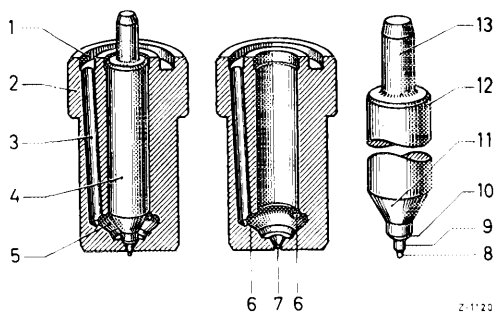
Do not apply excessive pressure with cleaning cutter.

Clean center hole (15 in fig. item 4) with cleaning needle (0.13 mm dia. or 0.18 mm dia.).

7 Clean injection hole in nozzle orifice, using injection hole cleaner. As can be seen in the illustration, work **from inside to outside** and not vice versa (so that injection hole cleaner is guided correctly and not twisted).



8 Clean nozzle needle with brass brush.

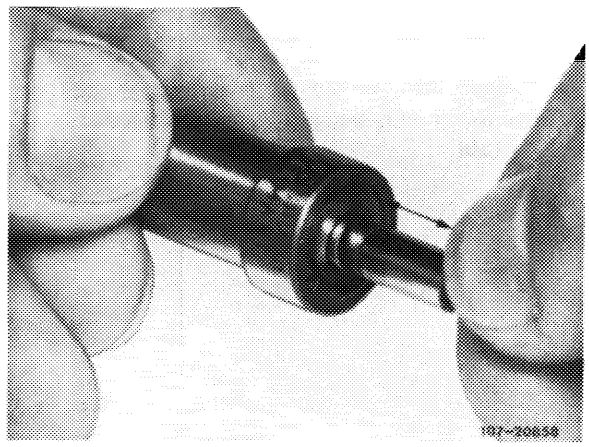


1 Annular groove
2 Nozzle body
3 Inlet port
4 Needle valve
5 Pressure chamber
6 Orifice of inlet ports in pressure chamber
7 Nozzle orifice
8 Injection pin
9 Throttle pin
10 Needle valve seat
11 Pressure shoulder
12 Needle stem
13 Thrust pin

Checking the needle valve

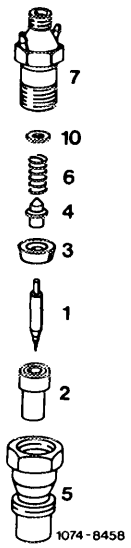
9 Subject to sight-check. Used nozzles are to be sight-checked after cleaning. Check needle valve for indented or rough seat, and also for worn or damaged injection pins. Exchange any nozzle that is damaged.

10 Carry out test for freedom of movement. To do so, immerse needle valve and nozzle body in filtered diesel fuel, inserting needle valve into nozzle body. Hold nozzle body vertically and draw needle valve out by about one third. It must be able to slide back into its seat under its own weight. Exchange injection nozzle if necessary.

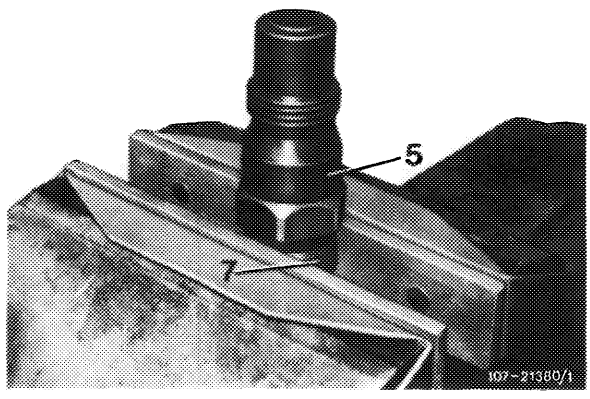


Assembly

11 Introduce all parts into lower part (5) of injection nozzle in reverse order and screw on upper part (7). Be sure to fit thrust pin (4) on needle valve (1) at end showing hole.

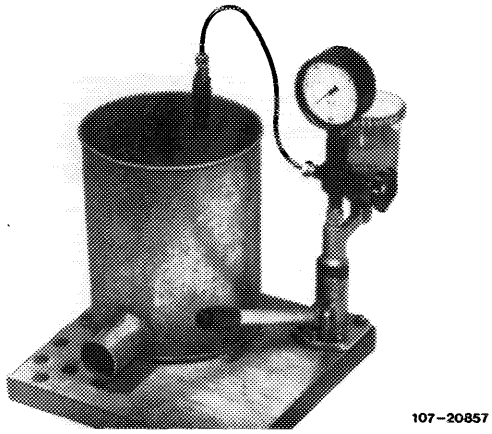


12 Clamp upper part (7) of injection nozzle in vise and torque lower part (5) to 70–80 Nm.



Checking

13 Check injection nozzles for satisfactory jet, rattling sound, injection pressure and leakage (07.1–135).

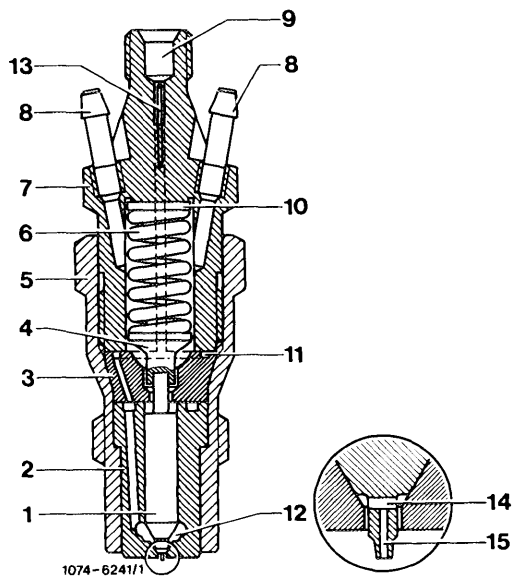


Adjustment

14 In order to obtain correct injection pressure setting, it may be necessary to insert or remove steel shims (10) between compression spring (6) and upper part (7) of injection nozzle.

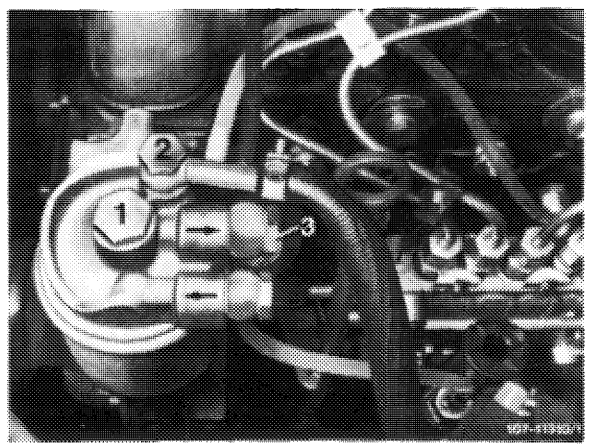
Inserting = higher injection pressure
Removing = lower injection pressure

These shims are available in thicknesses of 1.0 to 1.8 mm, in steps of 0.05 to 0.05 mm. Increasing the preloading by 0.05 mm increases the injection pressure by about 3.0 bar positive.

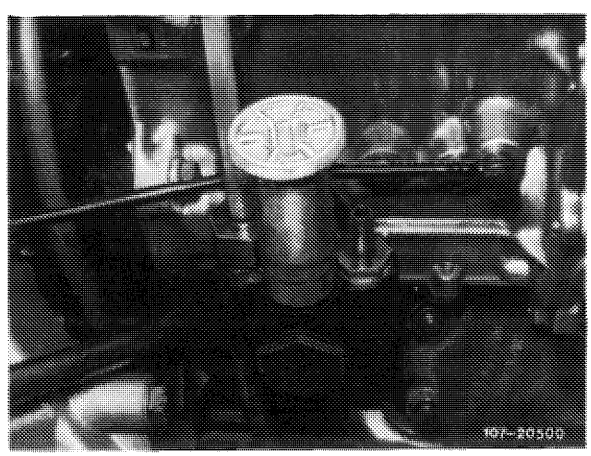


Venting fuel filter

1 Release union screw (3) at fuel filter.



2 Release knob on hand feed pump and operate this pump until clear fuel (containing no air bubbles) emerges from union screw. Now tighten union screw again.



Venting injection pump

3 Operate hand pump until bypass valve at injection pump opens (audible rattling sound).

4 Retighten knob on hand feed pump.

Note: This forces the pump piston against a sealing ring and seals the hand pump off from atmosphere. If knob is released during operation, hand feed pump will leak, allowing air to enter fuel system.

5 Run engine and check whether all connections are tight.

07.1–145 Checking fuel pump and bypass valve

Job no. of flat rates or standard texts and flat rates data 07–8800 or 5700.

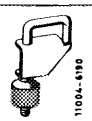
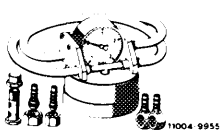
Test values

Bosch designation		FP/K 22 MW 8, MW 22
Vacuum	Measuring point	prior to fuel pump inlet
	at idle speed bar vacuum	0.1
Delivery pressure	Measuring point	between fuel pump and main fuel filter
	at idle speed bar gauge pressure	0.6– 0.8
	at 3000/min bar gauge pressure	min. 0.8
Delivery end pressure	at idle speed bar gauge pressure	min. 1.1
	at 3000/min bar gauge pressure	min. 1.3

Fuel bypass valve

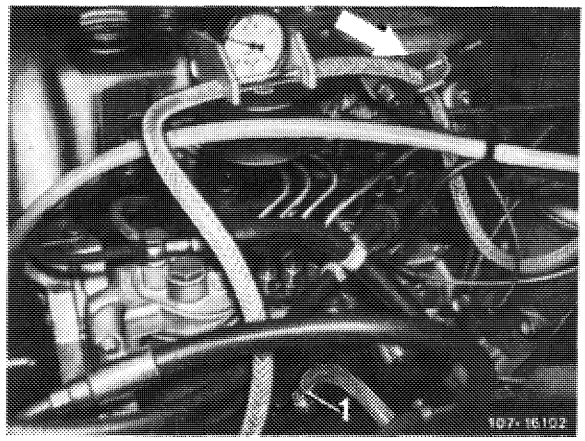
	Opening pressure in bar gauge pressure
at idle speed	0.6–0.8
at 3000/min	min. 1.3

Special tools

Clip for fuel hose		000 589 40 37 00
Tester for fuel pump		617 589 04 21 00

Measuring negative pressure

1 Connect tester to fuel inlet (1) on fuel pump. For this purpose, remove fuel feed line. Vent injection system (07.1–140).



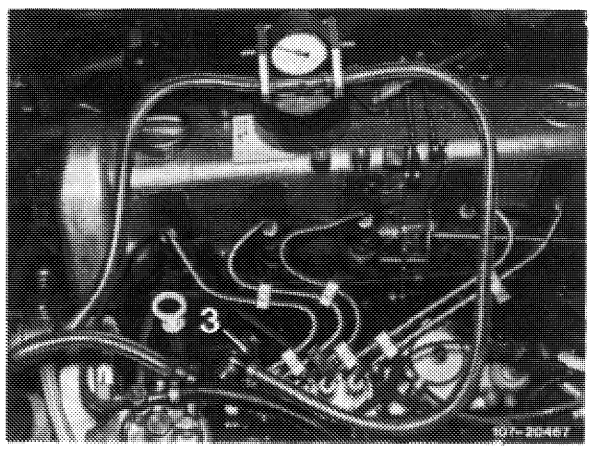
Measure vacuum pressure at idle speed. To do so, use clip to nip hose (arrow) at tester downstream of pressure gage.

If system fails to reach value of 0.1 bar vacuum, exchange suction and delivery valves or fuel pump (07.1–240).

Checking fuel feed pressure

2 Unscrew fuel line (3) on fuel main filter.

3 Connect tester. For this purpose, connect fuel line to hose line for tester with a double hollow screw and closing nut. Connect other hose line of tester to fuel filter.



4 Vent injection system (07.1–140).

5 Warm up engine.

6 Measure fuel feed pressure at idle speed and 3000/min.

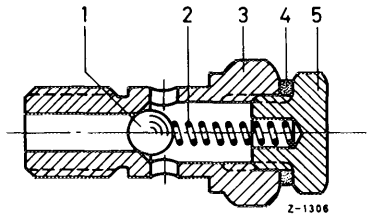
0.6–0.8 bar gauge pressure at idle speed.

Min. 0.8 bar gauge pressure at 3000/min.

7 What to do in case feed pressure is inadequate:

a) Check bypass valve, removing, disassembling and cleaning for this purpose.

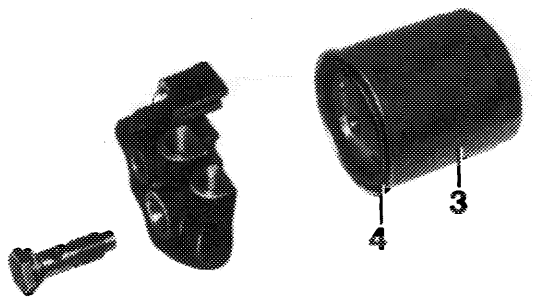
Increase preloading of compression spring (2), lengthening spring to 26–27 mm.



1 Ball
2 Compression spring
3 Body
4 Sealing ring
5 Screw plug

b) Check fuel filter for clogging. If necessary, **fit new filter element with body (3) and sealing ring (4).**

c) Exchange suction and delivery valves or fuel pump (07.1–235).



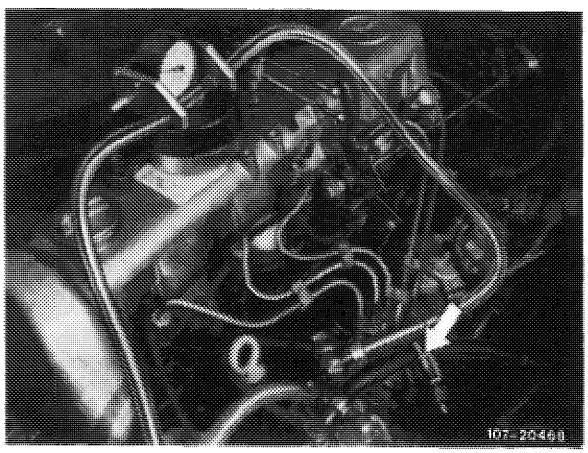
Checking final fuel feed pressure

8 Using clip (arrow), nip fuel return hose.

9 Measure final fuel feed pressure at idle speed and 3000/min.

Min. 1.1 bar gauge pressure at idle speed.

Min. 1.3 bar gauge pressure at 3000/min.



10 If final feed pressure is inadequate, exchange suction and delivery valves or fuel pump (07.1–235).

07.1–150 Checking vacuum shutoff for leaks

Job no. of flat rates or standard texts and flat rates data 07–8222 or 8225.

A. Without Tester

Note concerning diaphragm vacuum pump

Installed:
Model 116 up to model year 1979.
Model 116 starting model year 1980, 123 and 126 are provided with piston vacuum pumps.

If engine oil appears in vacuum lines or brake booster, you may find that the diaphragm in the vacuum control unit or the one in the vacuum pump is defective.

The appearance of engine oil necessitates the replacement of the vacuum control unit and also of the vacuum lines carrying oil. The vacuum pump will have to be repaired and the brake booster exchanged if they show oil at the vacuum line connection.

Leakage through the vacuum pump diaphragm or through the vacuum control unit at the injection pump will allow engine oil to reach the combustion chambers through the suction pipe, causing a higher combustion temperature which may damage the precombustion chambers.

If the full length of the vacuum lines is a dark black it may be assumed that engine oil has entered the combustion chamber. In this case you are advised to check all the precombustion chambers.

Precombustion chambers which are cracked at the bottom or have burnt (scaly) ball pin surfaces, have to be exchanged because engine damage due to breaking precombustion chamber parts will otherwise have to be taken into account.

Checking

1 Run engine.

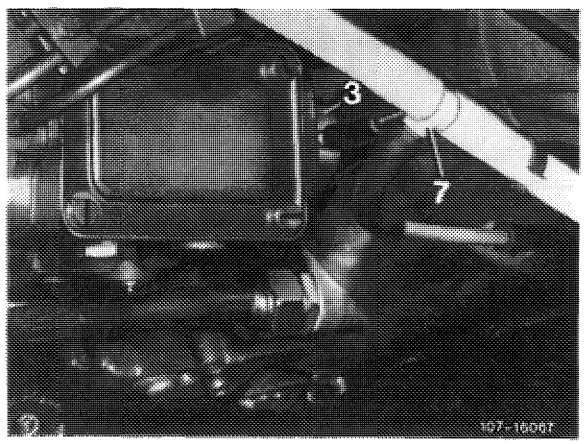
2 Disconnect vacuum line (brown) at Tee piece (7) and check whether pressure is negative or not.

a) Should this not be the case, unscrew vacuum line with Tee piece at vacuum pump and brake booster.

Check throttle in Tee piece for obstructions, blowing out with compressed air if necessary.

Note: On vehicles with diaphragm vacuum pump. If throttle is oiled up, diaphragm in vacuum pump may be defective. Throttle is defective, if engine oil shows up at connection of vacuum line (pump end). Reconditioning of vaccuum pump is described in repair instructions brakes model 115 and 123 (42–620).

b) If pressure at Tee piece is negative, connect vacuum control unit (3) straight to Tee piece (7) via a hose.

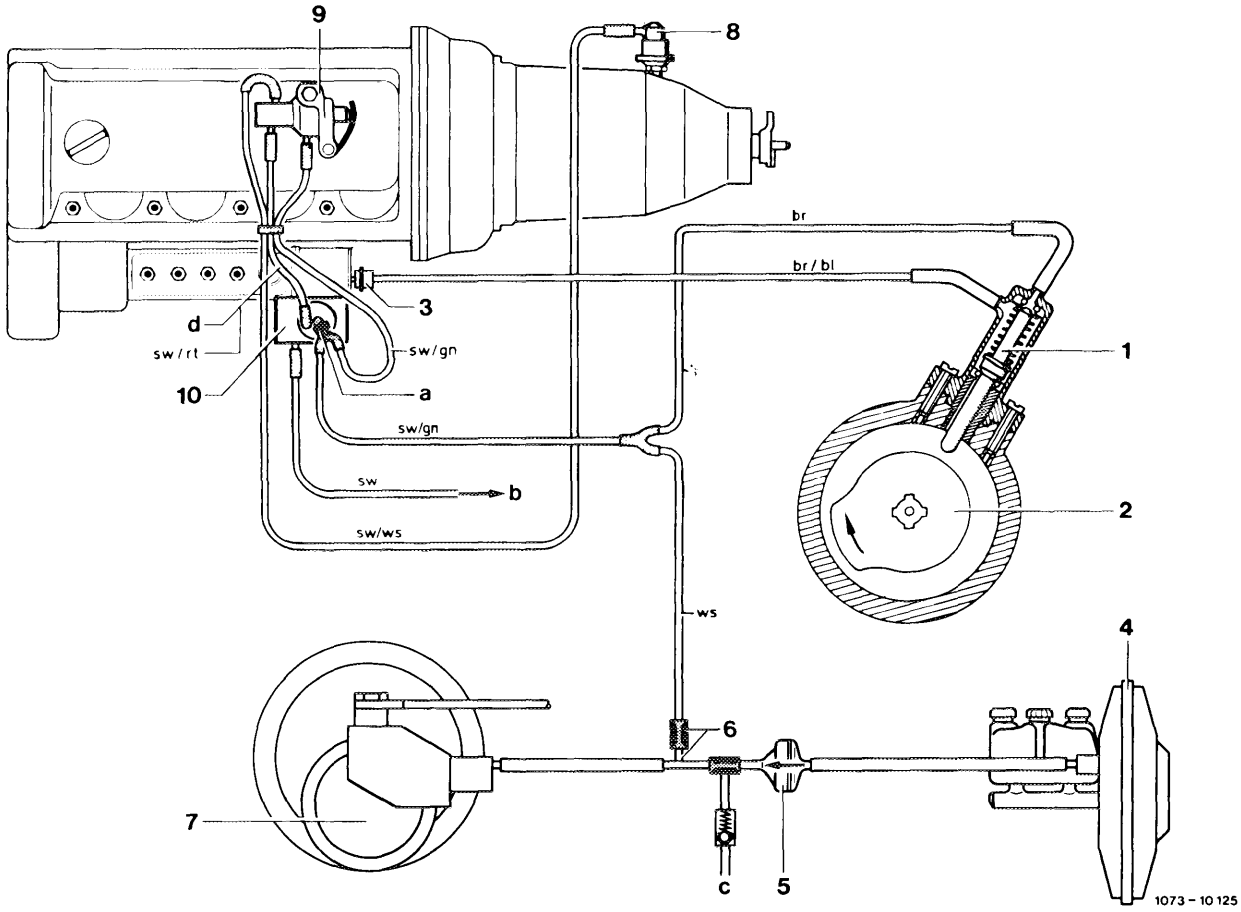


The vacuum from vacuum pump (8) now acts direct on the diaphragm in vacuum control unit (3) and draws the injection pump control rod to the stop position.
Exchange the vacuum control unit if engine does not stop immediately (07.1–220).

Immediate stoppage of engine means that vacuum control unit is in good working order. In this case, trouble may be due to sticking of valve (1) in steering lock. Exchange valve with reference to repair instructions for steering system models 115 and 123 (46–640).

Attention:
Do not cross vacuum lines when reconnecting.

3 Run engine. Check vacuum control unit and valve in steering lock for satisfactory operation, and examine injection pump for leakage.



1 Valve
2 Cam plate
3 Vacuum control unit
4 Brake booster
5 Check valve
6 T-piece with integratied throttle
7 Vacuum pump
8 Vacuum control unit transmission
9 Change-over valve
10 Vacuum control valve

a Suction line
b Vent line
c Central lock
d Control line

br = brown
br/bl = brown/blue
sw/rt = black/red
sw/gn = black/green
sw = black
sw/ws = black/white

B. With tester

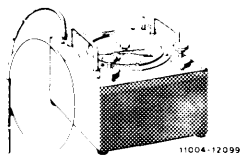
Data

Permissible system leakage	6 mbar/min at 400 mbar negative pressure
Permissible leakage at component parts	5 mbar/min at 300 mbar negative pressure
Mating length at connections	12 ± 2 mm

Color coding of vacuum lines for diesel engine key starting system

Vacuum line	Color code
Suction line from distributor to valve for key starting system (100)	brown
Control line from key starting system valve to vacuum control unit of injection pump (101)	brown/blue

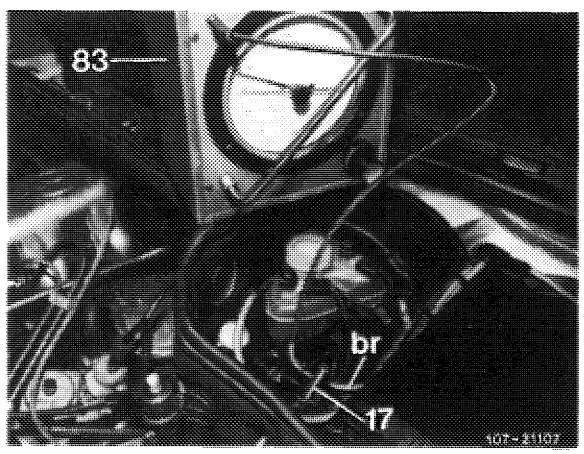
Special tool

Tester for vacuum and gauge pressure		201 589 13 21 00

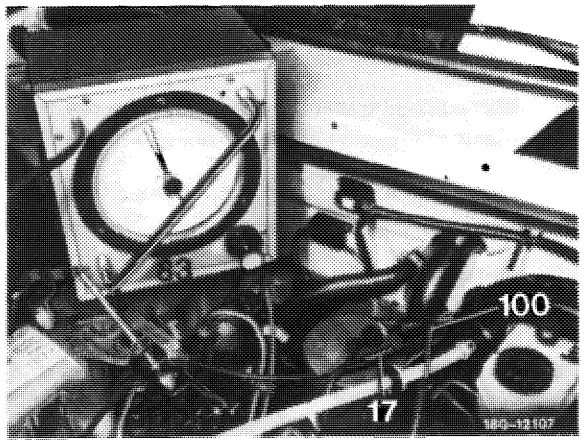
Checking

1 Turn ignition key in steering lock to position "2".

2 Pull brown line (br) out of connection (17) and connect tester (83) to brown line (br).



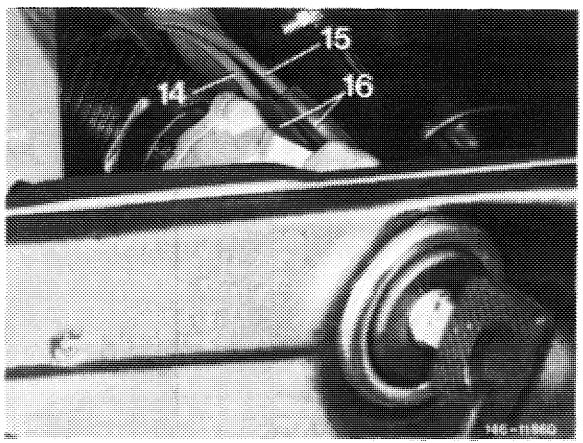
3 Evacuate tester (83).



4 Rising pressure on gage means that key starting system valve at steering lock is subject to leakage.

5 Exchange key starting system valve at steering lock (46–640).

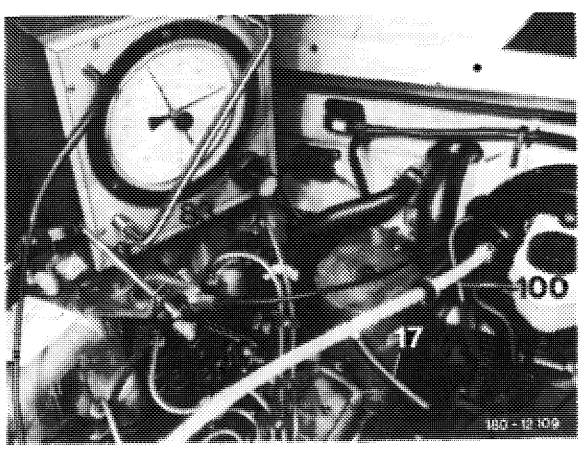
Attention:
Prior to exchanging key starting system valve and vacuum control unit of injection pump, check hose lines and connectors.



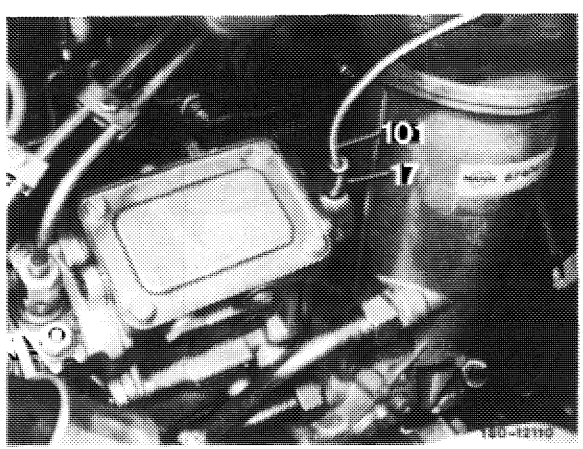
6 Turn ignition key in steering lock back to position "1" or "0".

7 Evacuate system using tester (83).

8 Rising pressure on gage may imply that vacuum control unit or valve is subject to leakage.



9 Disconnect control line (101) with connector (17) from vacuum control unit of injection pump.

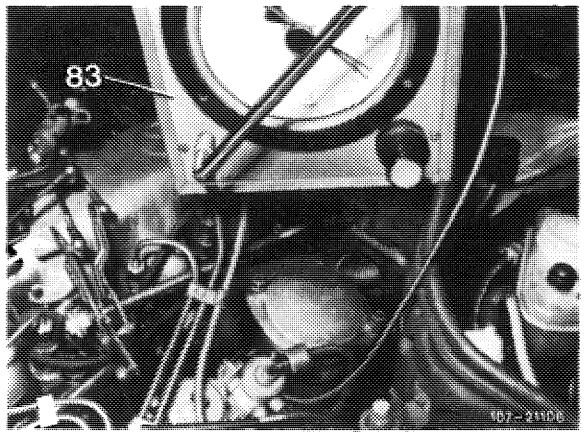


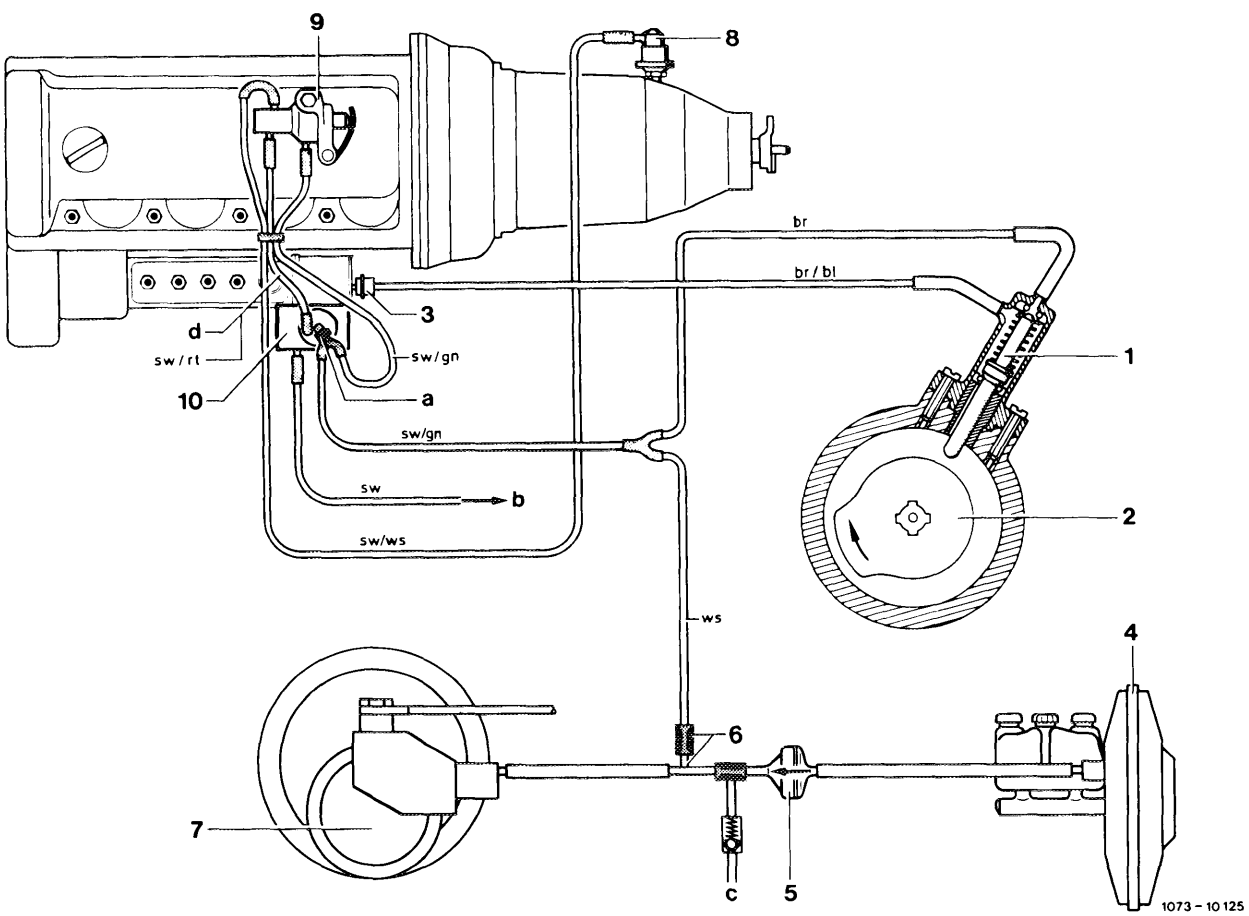
10 Connect tester (83) to vacuum control unit and evacuate.

11 Rising pressure on gage means that vacuum control unit of injection pump is subject to leakage.

12 Exchange vacuum control unit of injection pump (07.1–220).

13 Constant pressure on gage means that vacuum control unit of injection pump is in order and that key starting valve is subject to leakage. Exchange key starting system valve (46–640).





1 Valve
2 Cam
3 Vacuum control unit
4 Brake booster
5 Check valve
6 T-fitting with installed throttle (orifice)
7 Vacuum pump
8 Vacuum control unit for transmission
9 Changeover valve
10 Vacuum control valve

a Suction line
b Positive vent line
c Central lock
d Control line

br =brown
br/bl = brown/blue
sw/rt = black/red
sw/gn = black/green
sw = black
sw/ws = black/white

07.1–200 Removal and installation of injection pump

Job no. of flat rates or standard texts and flat rates data 8410 or 8411, 8430, 8431.

Survey model – engine – injection pump

Model	Engine	Injection pump Bosch designation	Regulator Bosch designation	Delivery pump Bosch designation	Test values[1] 1B-sheet Edition
Standard version up to 1980					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
Standard version starting 1981					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 8	3.0 g 1st edition
(USA) **1978/1979**		Identification: Green type rating plate			
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22	FP/K 22 MW 8	3.0 g 4th edition
(USA) **1980**					
116.120	617.950	PES 5 MW 55/320 RS 16	RW 375/2200 MW 22 RW 375/2200 MW 28[2])	FP/K 22 MW 22	3.0 g 4th edition
(USA) **1981**					
123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–1	FP/K 22 MW 22	3.0 g 5th edition
126.120	617.951				
(USA) **starting model year 1982**					
123.133 123.153 123.193	617.952	PES 5 MW 55/320 RS 16	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120	617.951				

(USA) starting model year 1984 California

123.133 123.153 617.952 123.193	PES 5 MW 55/320 RS 16–1	RW 375/2200 MW 28–3[3])	FP/K 22 MW 22	3.0 m 1st edition
126.120 617.951				

[1] Accurate checkup and adjustment of injection pump is possible on an injection pump test bench only. For workshops, where such a test bench is installed, test sheets for the different pumps are available.
[2] Entering production starting February 1980.
[3] Reference impulse verification (RIV), dynamic injection timing (begin of delivery) test possible.

Tightening torques	Nm
Pipe connection for delivery valves	40–50
Injection lines	25

Special tools

Socket 13 mm, 3/8" drive		000 589 21 07 22
Box wrench socket open, 17 mm, 1/2" drive for injection lines		000 589 68 03 00
Overflow pipe		636 589 02 23 00

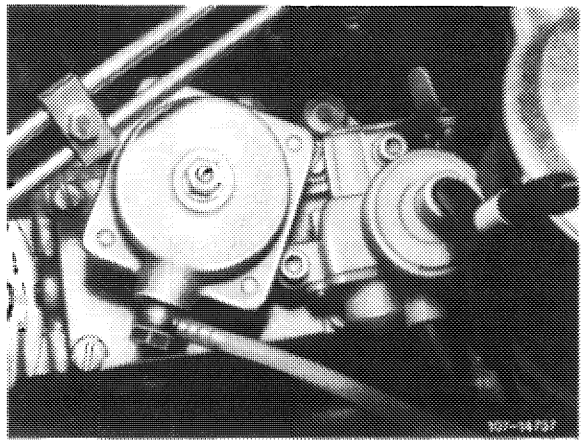
Conventional tool

Torque wrench 1/2" drive, 15–65 Nm

Removal

1 Detach vacuum line at vacuum control unit and at vacuum control valve for automatic transmission.

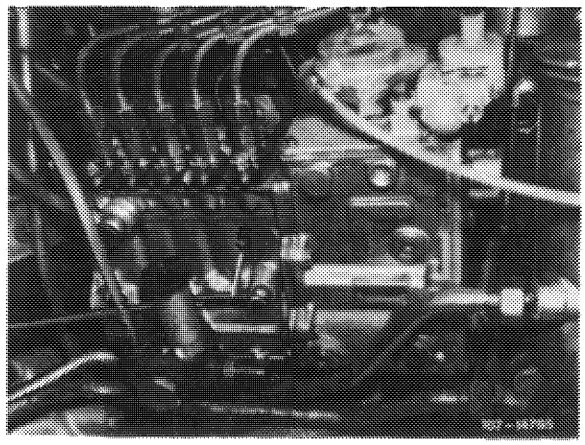
2 Unscrew delivery line at aneroid compensator.



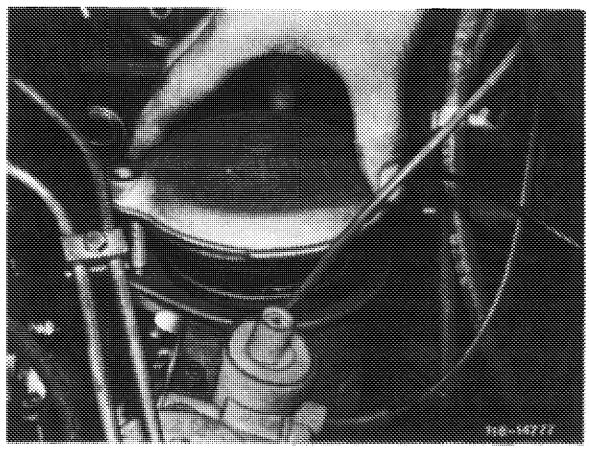
3 Disconnect electric cable at temperature sensor, detach control rod, unscrew injection lines and fuel lines at injection pump. Clip caps onto connections for injection lines and fuel hoses at injection pump.

4 Unscrew lubricating oil line (5).

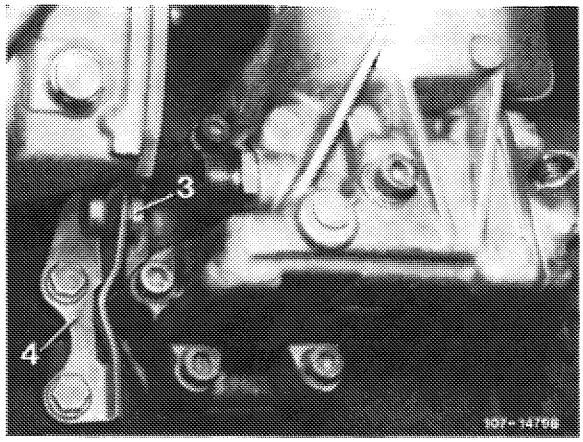
Attention:
Prior to removal of lubricating oil line (5), clean connecting points.



5 Unscrew and remove upper part of oil filter so that engine oil can return to oil pan.



6 Unscrew hex-head bolts at supporting holder (4) as well as 3 nuts holding injection pump. Release feastening bolt (3) to provide adjustment within oblong hole.

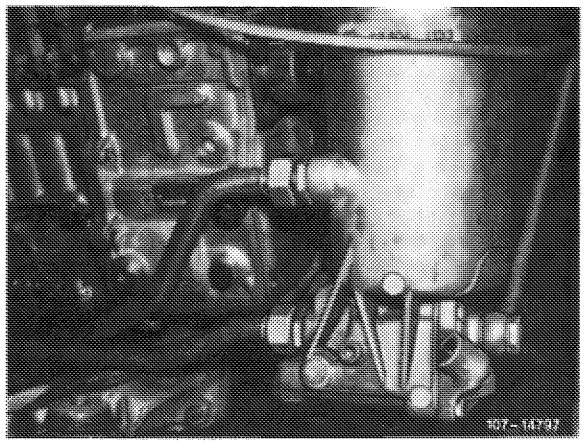


7 Unscrew all engine oil lines at oil filter body, releasing clamps for this purpose.

8 Unscrew and remove oil filter body from crankcase (18–110).

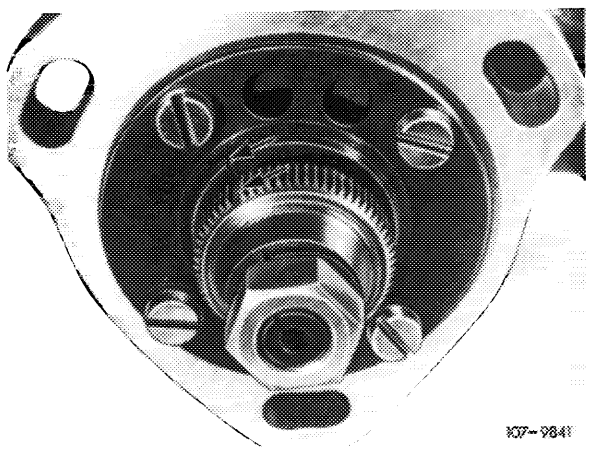
Attention:
When removing gasket, make sure that no remains drop into oil passages.

9 Withdraw injection pump from crankcase. Detach coupling sleeve from injection pump driver or from drive shaft.



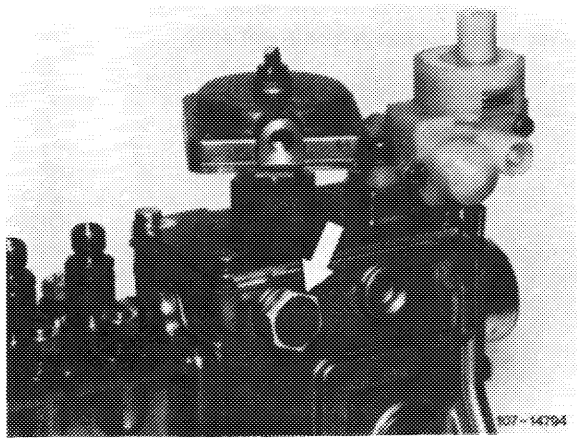
Note: If driver is to be exchanged, lock driver with serrated wrench and release hexagon nut. Then remove driver from injection pump shaft using puller. Clean axle stub and driver, making sure that both cones are absolutely clean and dry.

When fitting a new driver, note Woodruff key and marks (arrows).



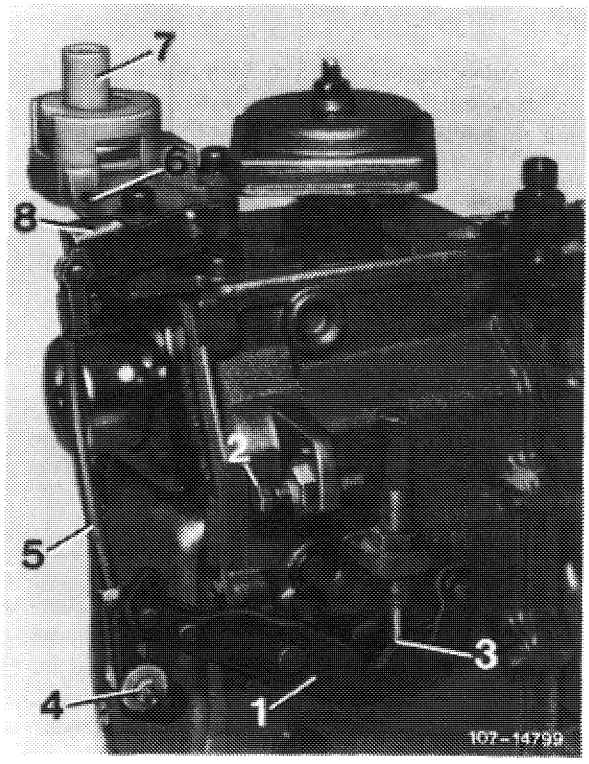
Installation

Attention:
Prior to installing a replacement injection pump, remove screw plug (arrow) and fill with 0.4 l engine oil (first filling).



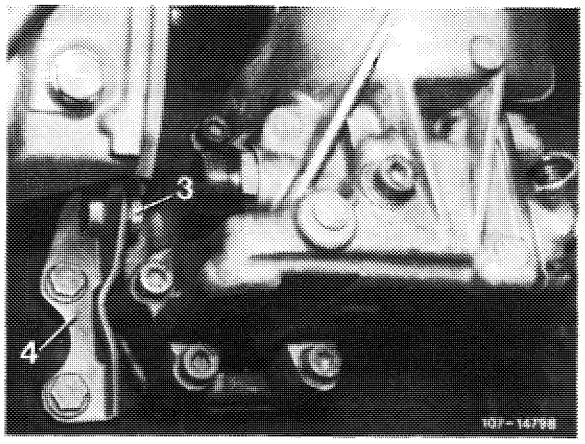
10 Check whether connecting rod (5) is correctly set, moving control lever (1) to full-load stop (2) for this purpose. Operating lever (8) must have approx. 0.5 mm clearance from full-load stop (6).

If necessary, adjust connecting rod (5) at adjustable knuckle (4).

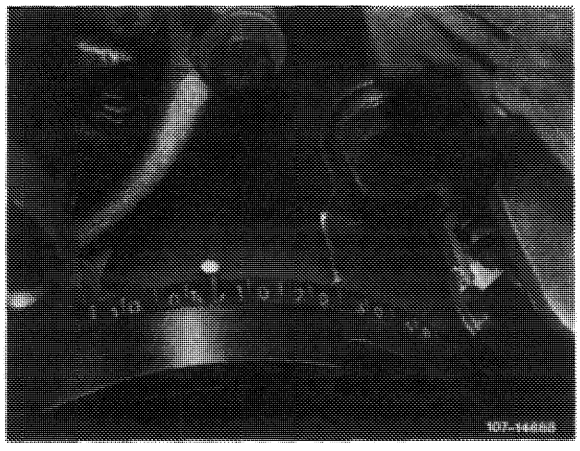


1 Control lever
2 Full-load stop
3 Idle speed stop
4 Adjustable knuckle
5 Connecting rod
6 Full-load stop at vacuum control valve
7 Vacuum control valve
8 Operating lever for vacuum control valve

11 Detach supporting holder (4) from removed injection pump and bolt to injection pump for installation. Do not tighten fastening bolt (3) because adjustment within oblong hole is still necessary.



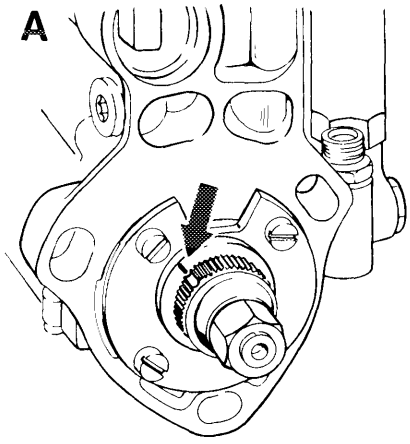
12 Move crankshaft to start of delivery in compression stroke.



13 Fit new gasket.

14 Move injection pump to mark, turning injection pump camshaft until mark on camshaft agrees with line on flange (arrow).

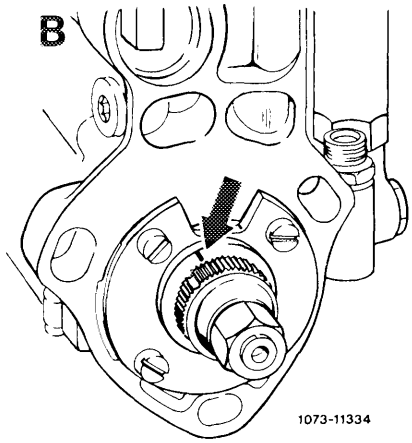
Attention!
On Bosch production code number "251" (November 1982) the mark for begin of delivery may be applied to the wrong spot on bearing cap.



Mark on bearing cap correct
(approx. center of bearing cap screw)

Note

When installing an injection pump with wrong mark on bearing cap, the pinion should be positioned in such a manner that the recess is 3 teeth to the left on the mark of the bearing cap. In this position the injection pump is at begin of delivery (basic position). The engine should be at 24° before TDC, as usual.



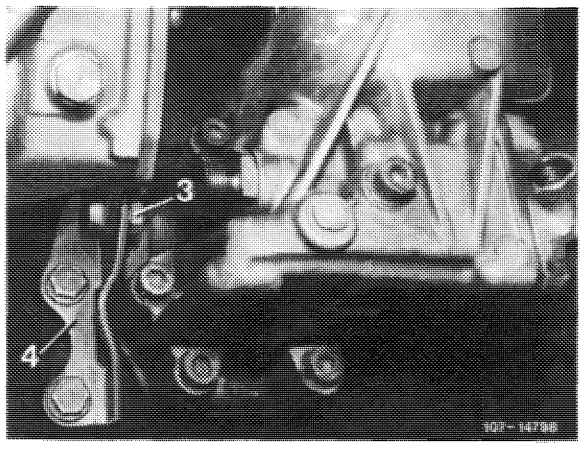
Marking on bearing cap wrong
(approx. lefthand edge recess of oil overflow)

15 Slip coupling sleeve onto driver and insert injection pump. Fit washers and slightly tighten fastening nuts of injection pump.

16 Check and adjust start of delivery (07.1–110 and 115).

17 Tighten injection pump fastening nuts and attach supporting holder (4) to crankcase. Now tighten fastening bolt (3) in oblong hole of supporting holder. Supporting holder is to be fastened with shims as per part No. 116 990 14 40 and hex-head bolts M 8 x 16.

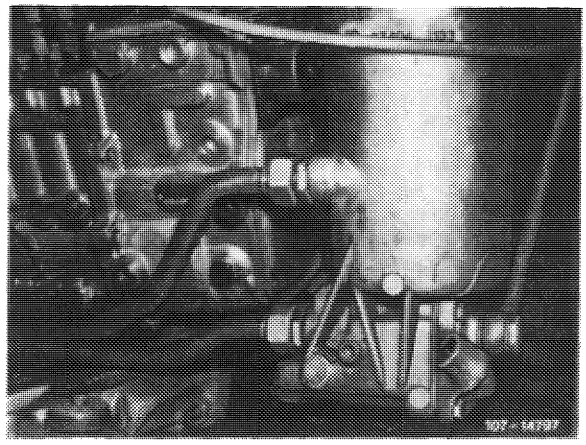
18 Reconnect lubricating oil line to injection pump.



19 Fit oil filter and oil filter cover with new seal.

20 Connect all oil lines to oil filter.

21 Attach temperature sensor cable, connect charge air line and vacuum lines to injection pump, and fit all fuel lines.



22 Vent injection system with hand delivery pump (07.1–140).

23 Check throttle linkage and adjust, if required (30–300).

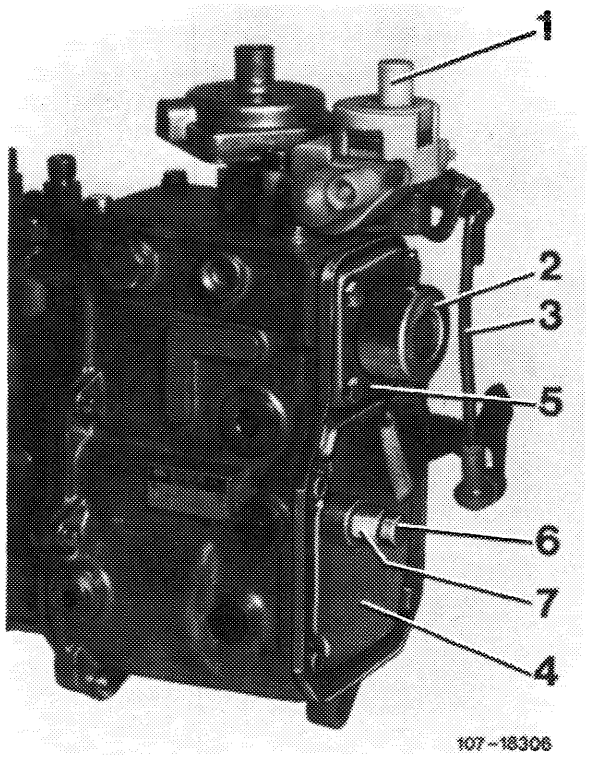
24 Run engine to operating temperature and check all connections for leaks.

25 Check idle speed and adjust, if required (07.1 - 100).

26 Adjust damper for regulator. If a damper (6) is installed on regulator of injection pump, adjust at idle against transverse vibrations of engine.

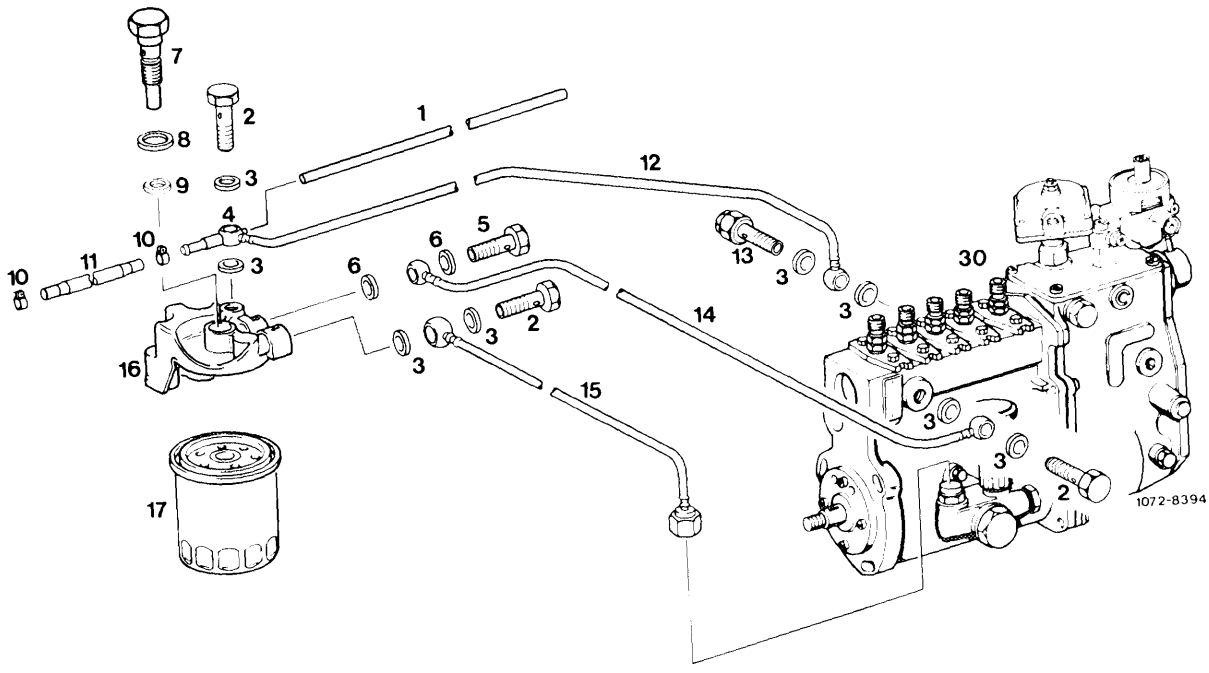
For this purpose, loosen counter nut (7).

Adjust damper (6) at idle speed, screwing damper in until transverse engine vibrations have been remedied. Then tighten counter nut (7) to 20–25 Nm.



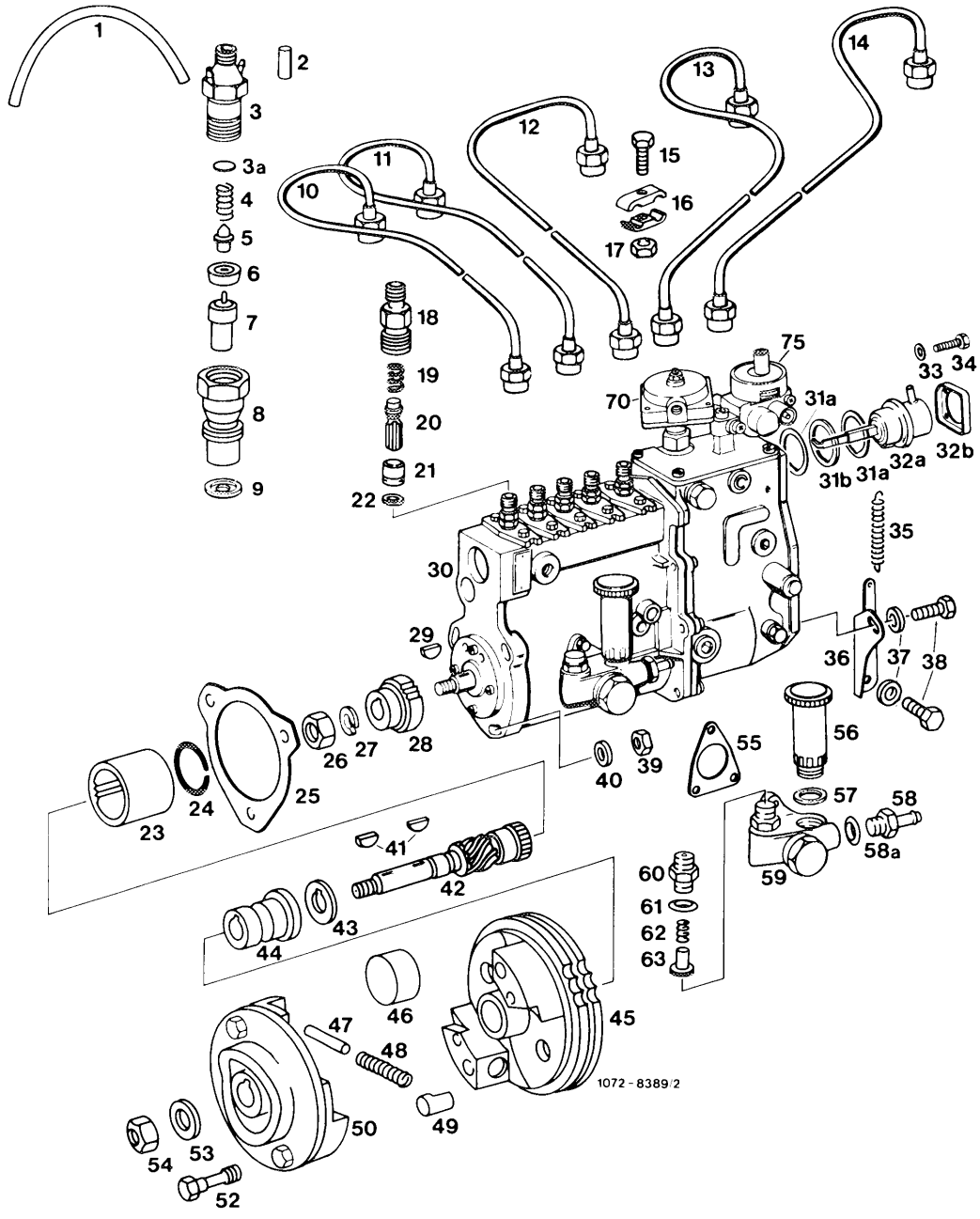
6 Damper
7 Counter nut

Fuel filter



1 Leak-off hose from injection nozzle
2 Union screw
3 Sealing ring
4 Banjo connector
5 Union screw
6 Sealing ring
7 Union screw
8 Sealing ring
9 O-ring
10 Hose clamp
11 Expansion hose
12 Return line from bypass valve
13 Bypass valve
14 Fuel line
15 Fuel line
16 Upper part of fuel filter
17 Fuel filter
30 Injection pump

Mixture Control

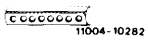


1	Leak-off hose	23	Seal	44	Socket
2	Stopper	24	Snap ring	45	Segment for injection timing device
3	Injection nozzle, upper part	25	Gasket	46	Centrifugal weight
3a	Steel shim	26	Nut	47	Pin
4	Compression spring	27	Lock washer	48	Compression spring
5	Thrust pin	28	Drive pinion	49	Pin
6	Nozzle holder insert	29	Woodruff key	50	Segmental flange
7	Nozzle body	30	Injection pump	52	Waisted bolt
8	Injection nozzle, lower part	31a	Gasket	53	Washer
9	Nozzle plate	31b	Steel washer	54	Nut
10	Injection line	32a	Vacuum control unit	55	Gasket
11	Injection line	32b	Flange	56	Hand-operated fuel feed pump
12	Injection line	33	Washer	57	Rubber sealing ring
13	Injection line	34	Bolt	58	Socket
14	Injection line	35	Return spring	58a	Sealing ring
15	Bolt	36	Holder	59	Fuel feed pump
16	Pipe holder	37	Washer	60	Screwed union
17	Nut	38	Bolt	61	Sealing ring
18	Pipe connection	39	Nut	62	Compression spring
19	Compression spring	40	Washer	63	Delivery and suction valve
20	Delivery valve	41	Woodruff key	64	Aneroid compensator
21	Delivery valve holder	42	Idler gear shaft	75	Vacuum control valve
22	Copper sealing ring	43	Thrust ring		

Adjusting value

Set engine to **–15° after TDC** of 1st cylinder

Special tools

Locking screw	 11004-11773	601 589 05 21 00
Driving square 1/2", 80 mm for rotating engine	 11004-10282	617 589 00 16 00

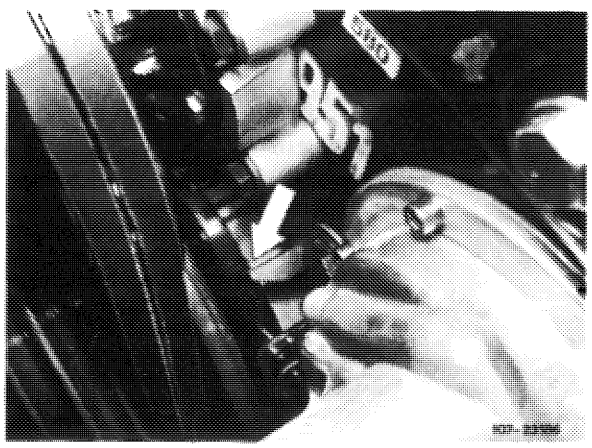
Note

Remove engine pump (07.1–200).

Installation

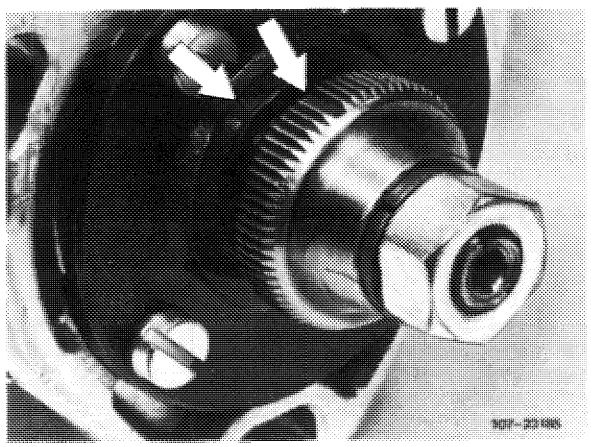
1 Rotate engine in direction of rotation once and set to –15° after TDC of 1st cylinder.

Note: Clearances must be compensated.



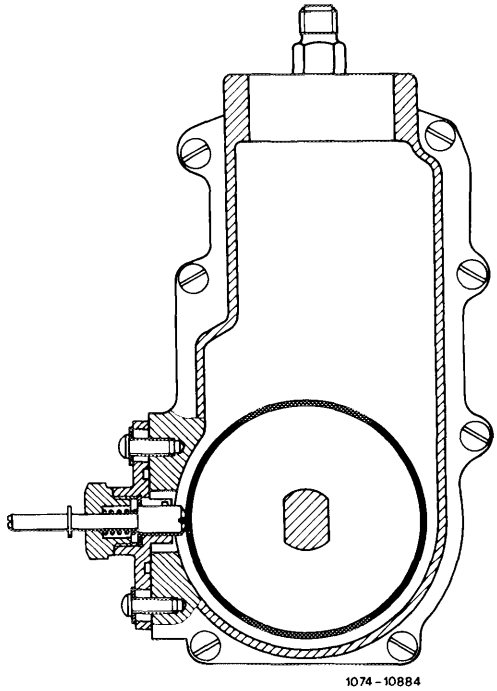
2 Mount new gasket.

3 Lock injection pump. For this purpose, rotate pump shaft until **4th tooth** on driver after tooth gap is in alignment with mark (arrows).



4 Slip in locking screw until there is a noticeable lock, turn camshaft slightly, if required.

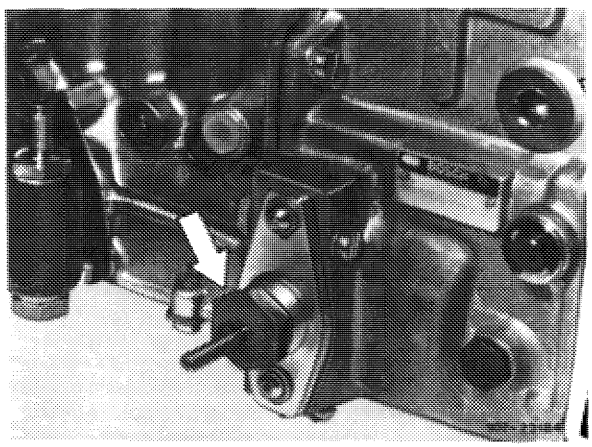
Tighten coupling nut manually.



5 Slip coupling sleeve on driver.

6 Install injection pump, tighten.

7 Remove locking screw (arrow). Additional jobs (07.1–200 starting item 16).



07.1–210 Replacement of pipe connection, delivery valve or copper sealing ring on injection pump

Job no. of flat rates or standard texts and flat rates data 07–8627.

Tightening torques	Nm
Pipe connection for delivery valve	40–50
Injection line	25

Special tools

Box wrench socket open, 17 mm 1/2" drive for injection lines	 11004-6359	000 589 68 03 00

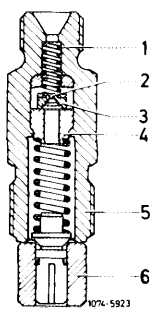
Conventional tool

Torque wrench 1/2" drive, 15–65 Nm

Note

To reduce hydrocarbons in exhaust gases, relief throttles are installed in pipe connections of injection pump.

Relief throttle (2) is a poppet valve (3) with an orifice of 0.6 mm dia. opening in direction of injection nozzle. Valve seat (4) is riveted into pipe connection.



1 Compression spring
2 Relief throttle
3 Peppet valve
4 Valve seat
5 Pipe connection
6 Delivery valve holder with valve

The relief throttle allows fuel to pass through freely in the direction of the injection nozzle. The pressure wave travelling toward the injection pump from the injection nozzle is caused by the secondary pumping action of the needle valve as it closes; this is attenuated by the relief throttle and prevented from returning to the injection nozzle where it would otherwise cause secondary injection. This in turn would increase the hydrocarbon content of the exhaust gases.

Removal

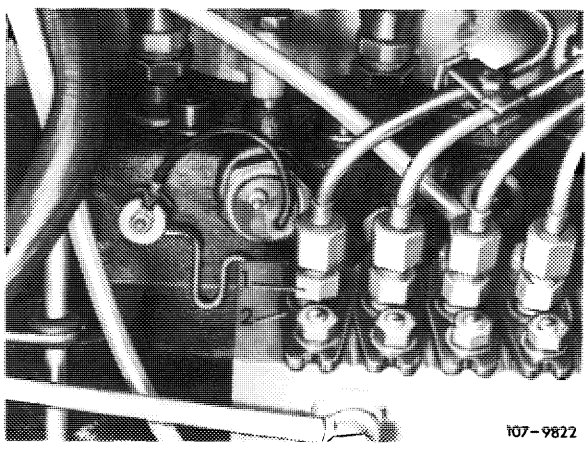
1 Clean injection pump at injection line cap nuts and at pipe connections.

2 Unscrew injection lines and pipe connection.

Attention:
Do not release assembly (2) because basic injection pump adjustment will otherwise have to be corrected on injection pump test bed.

3 Remove compression spring, copper sealing ring and delivery valve with holder.

4 Flush out injection pump suction chamber, using hand-operated feed pump. Remove foreign matter if necessary.

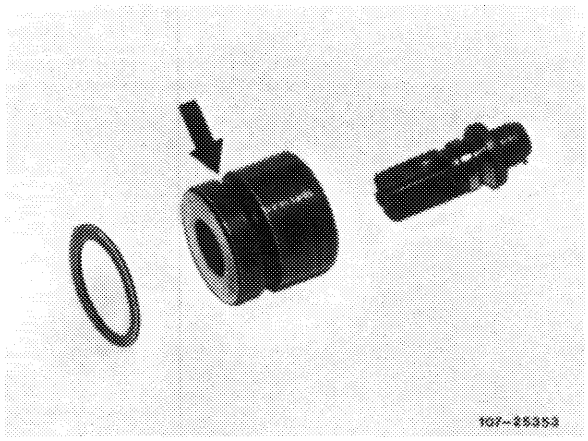


Installation

5 Clean delivery valve and holder, checking for damage and freedom of movement.

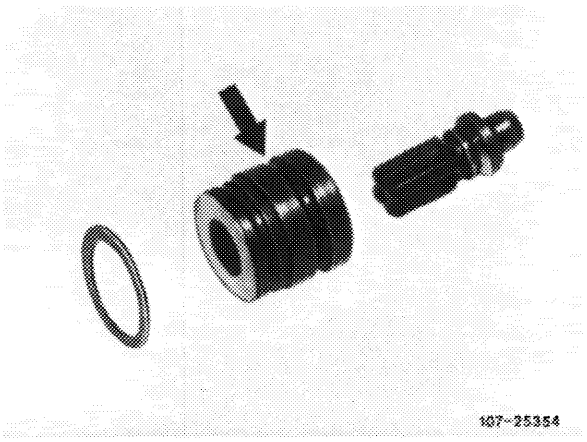
6 Position new copper sealing ring (5) **beneath** delivery valve holder (6).

On 1st version, the annular groove (arrow) must point in downward direction toward pump element.

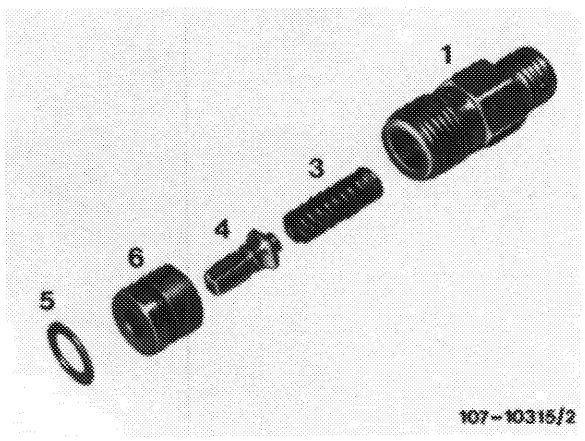


1st version

On 2nd version, the annular groove (arrow) must point toward delivery valve.



2nd version



1 Pipe connection
3 Compression spring
4 Delivery valve
5 Copper sealing ring
6 Delivery valve holder

7 Smear thread of pipe connection (1) with oil, insert and torque to 40–50 Nm in **one step.**

8 Connect injection lines and vent injection system (07.1–140).

9 Run engine, checking for leakage and smooth idling.

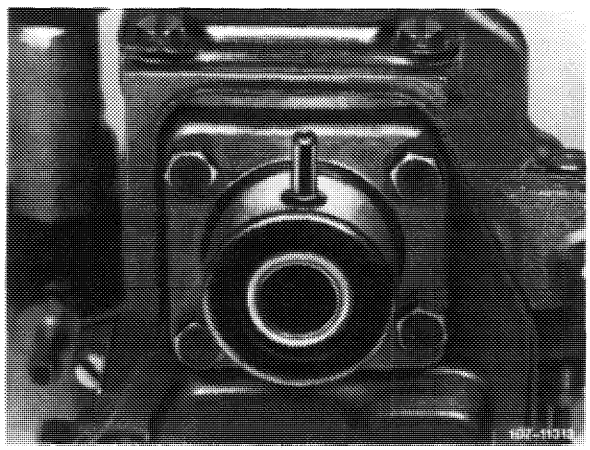
07.1–220 Replacement of vacuum control unit at injection pump

Job no. of flat rates or standard texts and flat rates data 07–8621.

Removal

1 Unscrew vacuum control valve on injection pump.

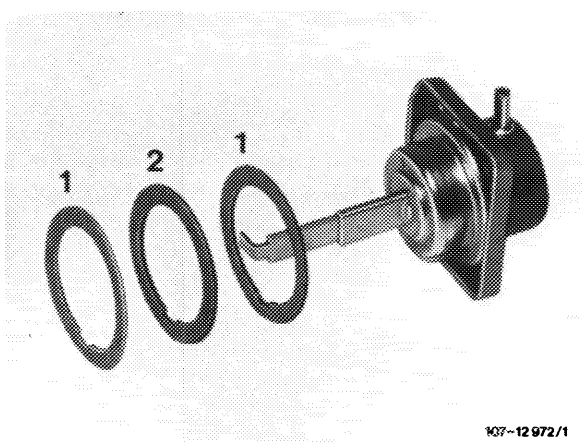
2 Remove vacuum control unit after loosening 4 fastening screws.



Installation

3 Bolt vacuum control unit to governor cover, using 2 new gaskets (1).

Make sure that connecting rod of vacuum control unit latches onto control rod.



1 Gasket
2 Steel ring

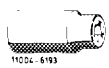
107-12972/1

07.1–230 Removal and installation of injection nozzles

Job no. of flat rates or standard texts and flat rates data 07–6810 or 6830.

Tightening torques	Nm
Injection nozzles	70–80
Injection lines	25

Special tools

Box wrench socket open, 17 mm, 1/2" drive for injection lines	 11004-6359	000 589 68 03 00
Socket for injection nozzle 27 mm, 1/2" drive	 11004-6193	001 589 65 09 00

Conventional tools

Torque wrench 1/2" drive, 40–130 Nm

Torque wrench 1/2" drive, 15–65 Nm

Removal

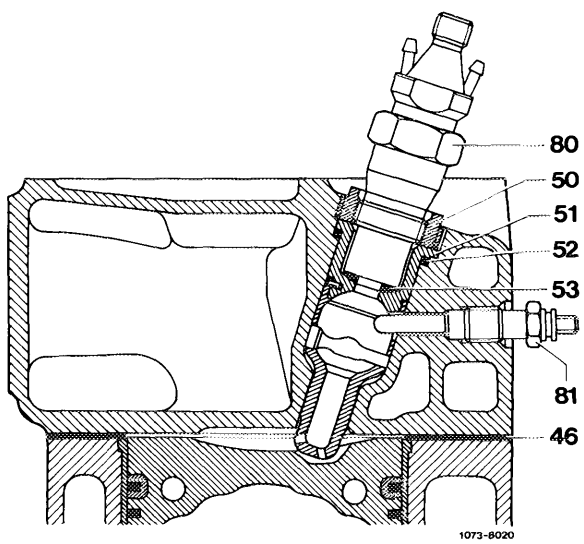
1 Unscrew injection lines.

2 Detach leak-off fuel hoses and plug of 5th injection nozzle.

3 Unscrew injection nozzles using socket. If precombustion chamber collar comes undone, tighten all collars (05–117).

4 Withdraw nozzle plate (53).

5 Sight-check precombustion chamber. Direct flashlight into chamber and examine whether ball pin is in satisfactory condition.



46 Cylinder head gasket
50 Collar
51 Precombustion chamber
52 Sealing ring
53 Nozzle plate
80 Injection nozzle
81 Pin-type glow plug

Installation

6 Install in reverse order, using new nozzle plates. Note tightening torques.

07.1–235 Removal and installation of fuel pump

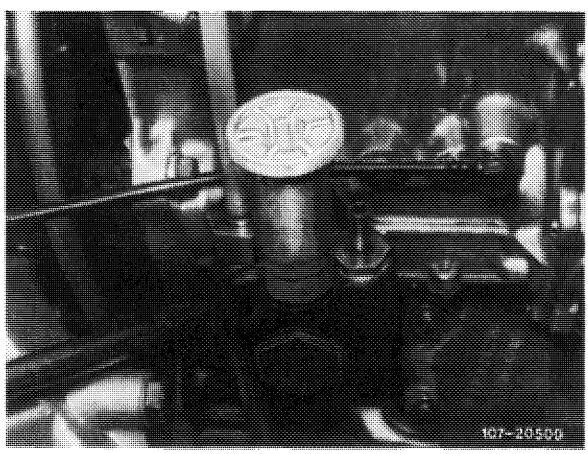
Job no. of flat rates or standard texts and flat rates data 07–5710.

Removal

1 Unscrew all fuel connections.

2 Release two fastening nuts and remove fuel pump.

3 Clean fuel pump, exchanging suction and delivery valves or fuel pump.



Installation

4 Fit fuel pump using new gasket.

5 Attach fuel connections and vent injection system (07.1–140).

6 Check fuel pump (07.1–145).

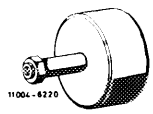
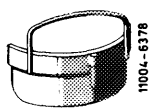
07.1–240 Removal and installation of injection timing device

Job no. of flat rates or standard texts and flat rates data 07–8014.

Testing data	
End play of intermediate sprocket shaft	0.05–0.12

Tightening torques	Nm
Hex-head bolt for injection timing device	40
Tightening bolt for camshaft sprocket	80

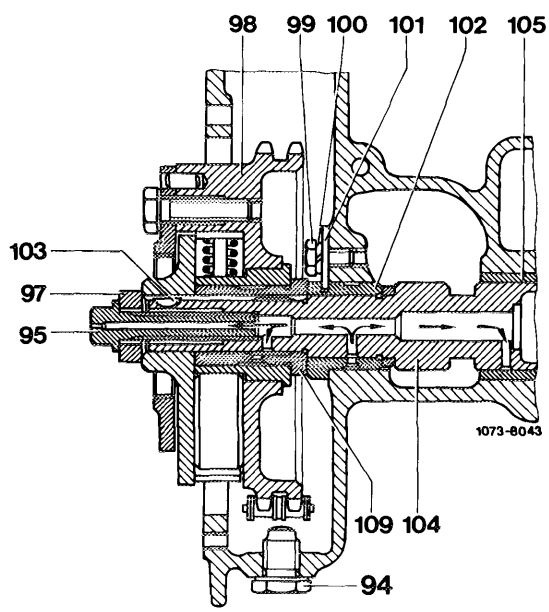
Special tools

Impact extractor for guide rail pins (basic unit)	 11004-6220	116 589 20 33 00
Stud M 6, 50 mm long	 11004-6368	116 589 01 34 00
Stud M 6, 150 mm long	 11004-6216	116 589 02 34 00
Supporting plate	 11004-6378	616 589 02 40 00

Note

The injection timing device is attached to the intermediate sprocket shaft (104) by a hex-head bolt (95).

Vacuum pump lubrication is provided via the intermediate sprocket shaft (104) and the hollow hex-head bolt (95). The adjustment range of the injection timing device amounts to 8° up to model year 1979, starting model year 1980 7.5°.



94 Retaining screw
95 Hex-head bolt M 10 x 45
97 Washer
98 Injection timing device
99 Bolt M 6 x 12
100 Lock washer B 6
101 Lock washer
102 Bearing bush
103 Woodruff key
104 Intermediate sprocket shaft
105 Bearing bush, rear
109 Bearing bush, injection timing device

Removal

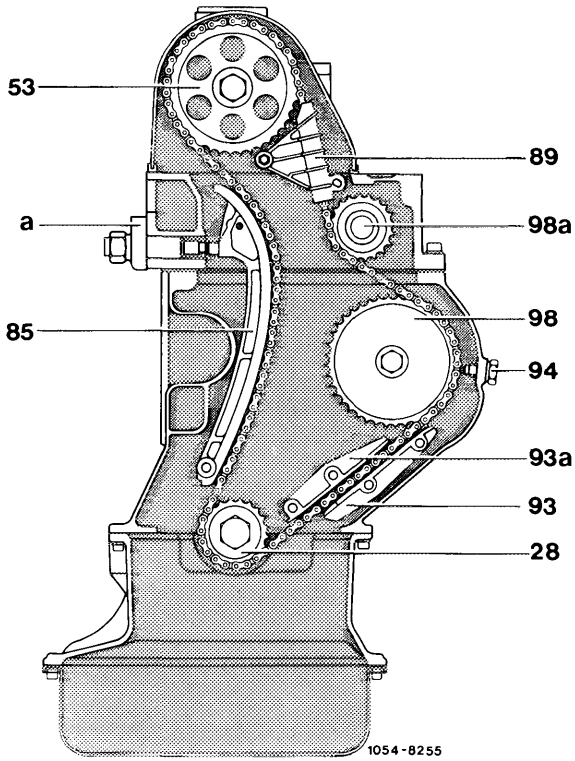
1 Remove radiator.

2 Unscrew suction and pressure line of diaphragm vacuum pump or suction line of piston vacuum pump and vacuum pump from cylinder crankcase.

3 Unscrew fastening nut of injection timing device.

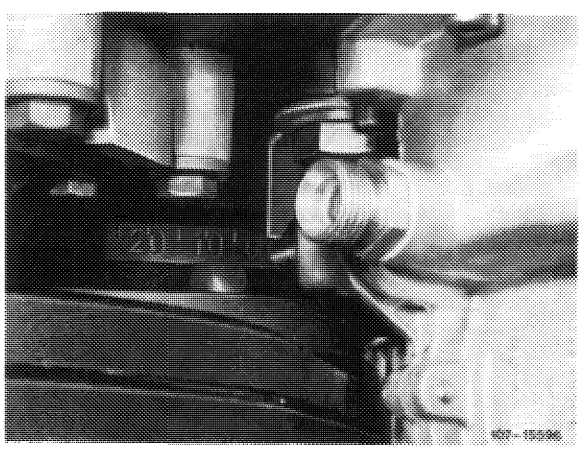
4 Remove cylinder head cover.

5 Unscrew bolt holding camshaft sprocket (53).

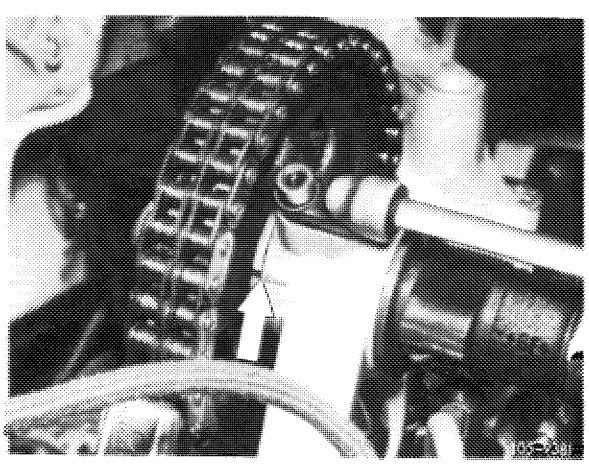


53 Camshaft sprocket
89 Guide rail
94 Retaining screw
93 Guide rail
93a Guide rail

6 Turn crankshaft in normal direction to TDC mark.



For correct camshaft alignment, position mark on shim adjacent to that on 1st camshaft bearing (arrow).



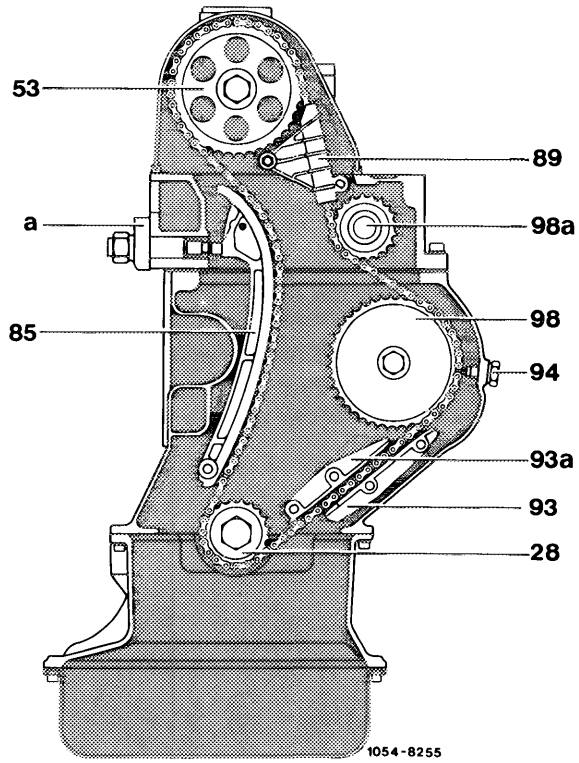
7 Using ink or paint, mark meshing point of chain on injection timing device, and position of injection timing device relative to crankcase.

8 Remove chain tensioner (05–310).

9 Unscrew hex-head bolts, withdraw bearing pin and then remove guide rail (89).

10 Detach camshaft sprocket, noting shim between camshaft and camshaft sprocket. Leave chain on sprocket and deposit together in chain box.

11 Unscrew chain drive retaining screw (94) and withdraw upper pin of guide rail (93) using puller.

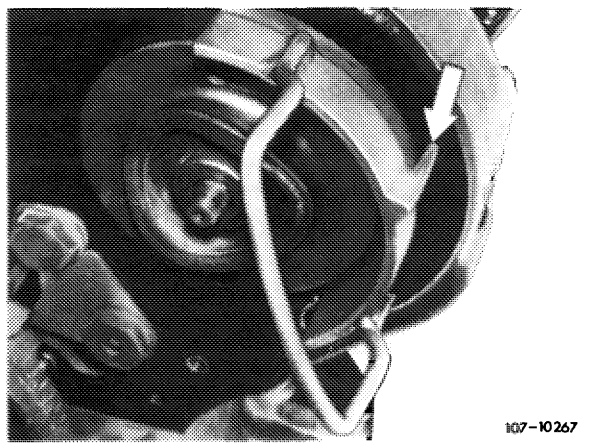


53 Camshaft sprocket
89 Guide rail
93 Guide rail
93a Guide rail
94 Retaining screw

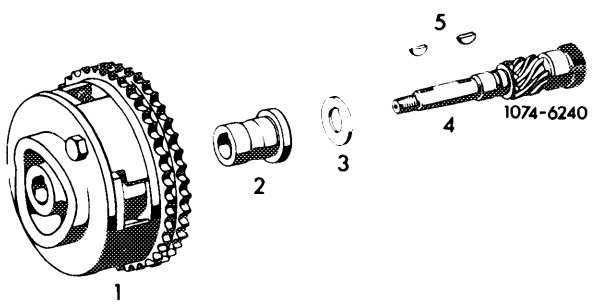
12 Lift chain out of injection timing device, sliding support plate between injection timing device and chain for this purpose. For better fixing, introduce guide pin (arrow) into tapped hole.

13 Remove or push off injection timing device.

Attention:
After removing injection timing device, be sure not to turn crankshaft or camshaft.



14 Remove injection timing device bush (2) and thrust ring (3) from intermediate sprocket shaft.



1 Injection timing device
2 Bush
3 Thrust ring
4 Intermediate sprocket shaft
5 Woodruff keys

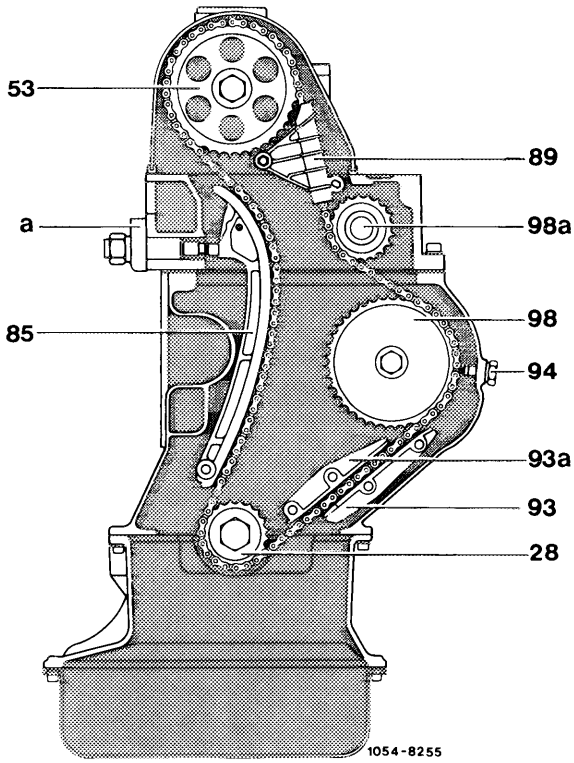
15 Check guide rails (93 and 93a) (sight-check), exchanging if necessary.

Installation

16 Oil thrust ring (3) and bush (2), slipping onto intermediate sprocket shaft. Make sure that both Woodruff keys (5) are correctly seated (illustration, No. 14).

Note: If injection timing device needs exchanging, position the old one on the new one in such a way that the keyways of the one agree with those of the other. The paint mark on the old injection timing device must now be transferred to the new one.

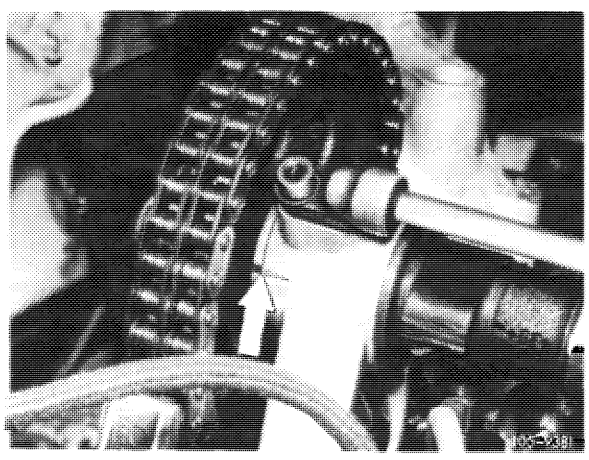
17 Slip injection timing device onto intermediate sprocket shaft.



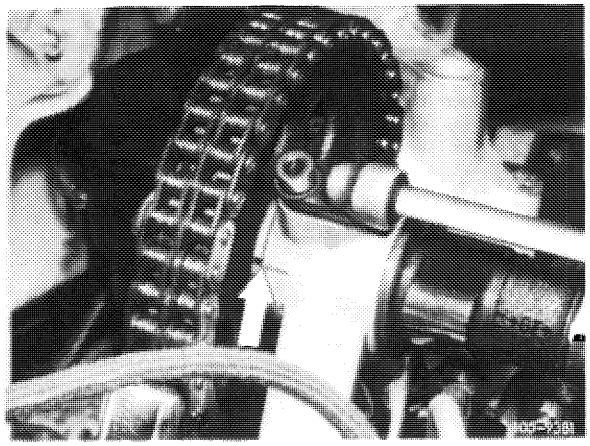
93 Guide rail
93a Guide rail

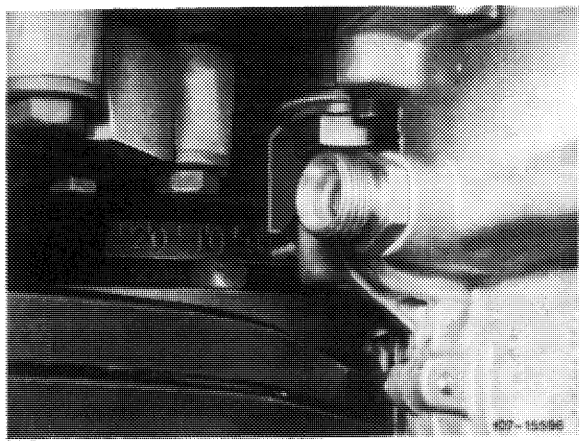
18 Draw chain upward and lift camshaft sprocket with chain, making sure that mark on injection timing device agrees with that on crankcase. If necessary, turn injection timing device until the two marks agree again. Then withdraw supporting plate. If marks are offset, insert supporting plate again and relocate chain on sprocket to make marks agree.

19 Slip camshaft sprocket and chain onto camshaft, making sure that mark in shim agrees with mark in first camshaft bearing.



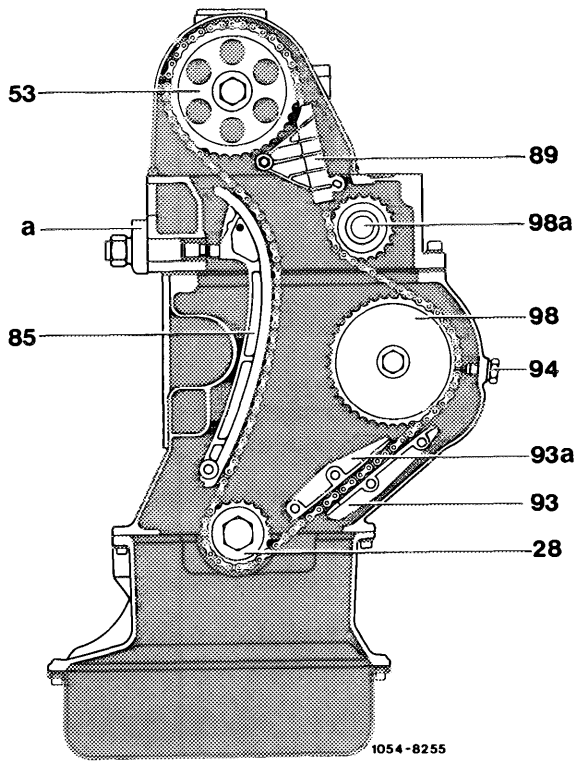
Check once again whether all marks are aligned in same way as before removal and whether TDC position of balance disk is correct.





20 Install chain tensioner (05–310).

21 Introduce bearing pin of guide rail (93a) into crankcase, coating pin end with sealant. While driving into position, make sure that wire retainer of guide rail *engages* notch in bearing pin.



22 Insert and tighten retaining screw (94) with new sealing ring.

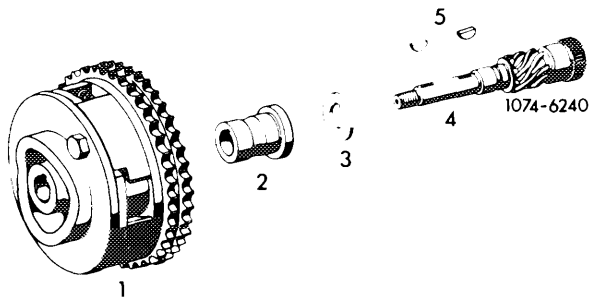
23 Check start of delivery adjusting if necessary (07.1–110 and 115).

24 Vent injection system (07.1–140).

25 Fit hollow hex-head bolt and torque to 40 Nm.

Attention:
Be sure to use hollow hex-head bolt only.

26 Check end play of intermediate sprocket shaft Specified value is 0.05–0.12 mm. Withdraw thrust ring (3) if necessary.



27 Insert camshaft sprocket bolt and torque to 80 Nm.

28 Check injection timing device for satisfactory operation, using a wrench to turn hexagon screw clockwise to stop. When screw is released, injection timing device must return to old position.

29 Fit vacuum pump with new gasket and connect vacuum lines.

30 Hold guide rail (89) in position, insert drive pin and tighten.

31 Fit cylinder head cover, making sure that rubber gasket is correctly seated.

32 Attach and check control linkage, adjusting if necessary (30–300).

33 Fit radiator and connect all lines.

34 Run engine and check for leakage.