Standard version and (USA)

Engine	601.911 standard version	601.921 (USA)
Injection pump	PES 4 M 55 C 320 RS 152	
Governor	RSF 375/2250 M 53	RSF 375/2250 M 56
Fuel pump	FP/KG 24 M 150	
Injection nozzle	DN 0 SD 261/–	DN 0 SD 24-/
Nozzle holder	KCA 30 S 44	KCA 30 S 46

The injection system differs from that of engines 615, 616 and 617 as follows:

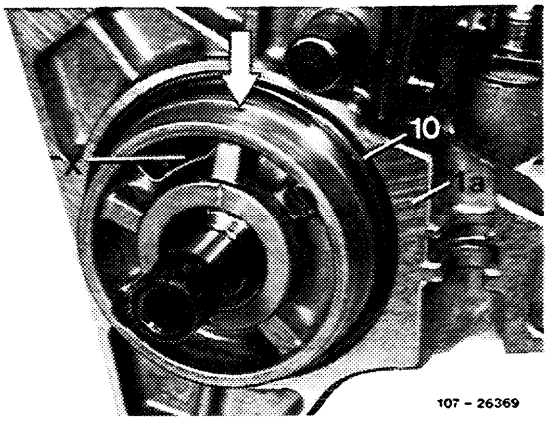
- Lubrication of injection pump.
- Relief throttle in delivery valve holder.
- Pneumatic idle speed increase.
- Reference impulse verification (RIV).
- Injection timing by means of adjusting device and injection pump flange.
- Injection system, self-venting.
- Fuel pump with higher delivery capacity, thereby eliminating hand pump.
- Overflow valve with throttle (orifice).
- Injection nozzle **as flat surface pintle** nozzle for standard version and as hole-type pintle nozzle for (USA).
- Injection timer mounted directly on injection pump shaft. Fastened by means of central bolt with **left-hand threads.**
- Fuel heater.

A. Lubrication of injection pump

The injection pump is connected to engine oil circuit by means of an oil bore (arrow).

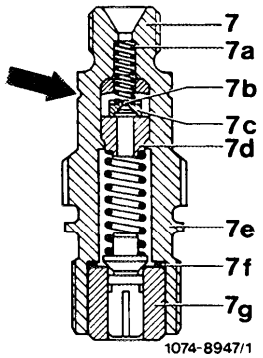
Oil return flow is by way of ring gap (x) between bearing and housing in cylinder crankcase.

An O-ring (10) is installed on flange (la) for sealing the clutch space between injection pump flange and crankcase.



B. Relief throttle in delivery valve holder

Relief throttles are installed in delivery valve holders of injection pump to reduce the hydro-carbon share in exhaust gas. An annular groove is located on delivery valve holder for identification (arrow). The relief throttle (7b) is a reed valve (7c) with an orifice of 0.6 mm dia., which opens in direction of injection nozzle. The valve seat (7d) is riveted into delivery valve holder.



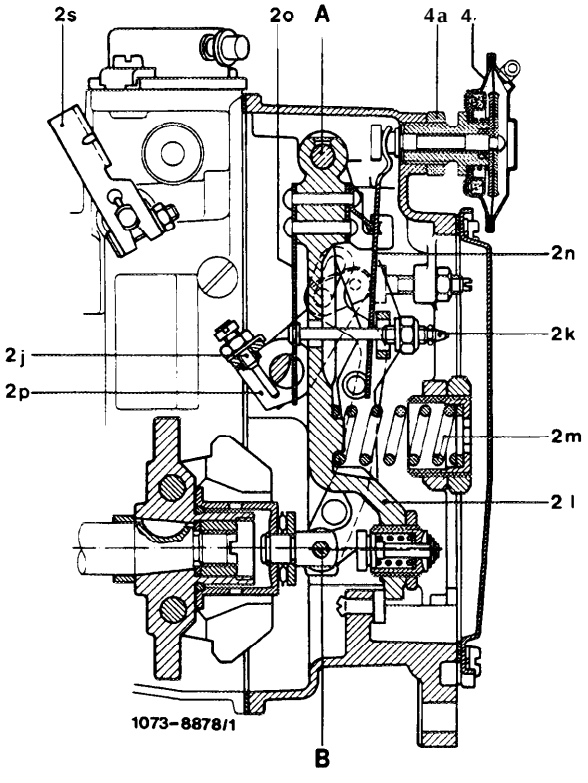
7 Delivery valve holder connection
7a Spring
7b Relief throttle
7c Reed valve
7d Valve seat
7e Delivery valve holder
7f Seal
7g Delivery valve

C. Layout and operation of RSF-governor

The governor is an idle speed-maximum speed governo with its regulating spring (2 m) measured and adjusted in such a manner that the governor will not govern in partial load range, apart from adaptation (refer to ,,Regulation during start and full load").

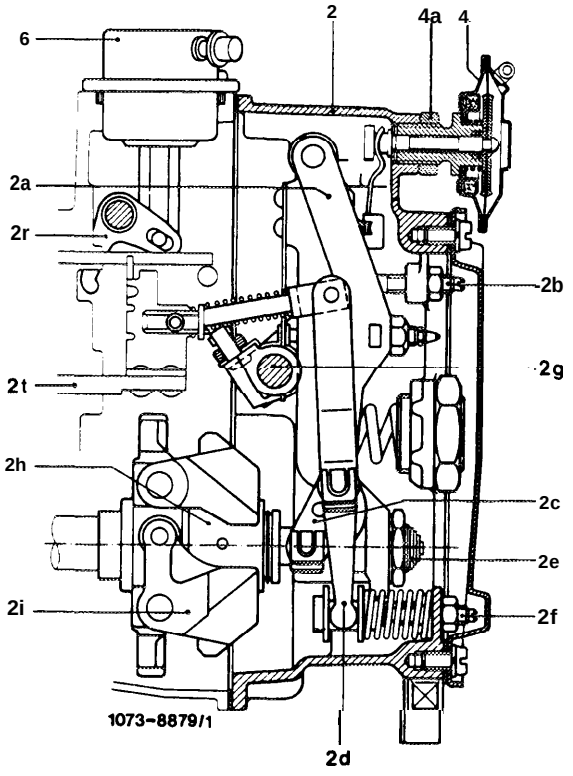
In partial load and full load range the control rod (2t) of injection pump is operated by accelerator pedal only, which is connected to adjusting lever (2g) of governor via regulating linkage.

The vacuum control unit (4) preloads the idle speed spring and adjusts the idle speed.



EXIT

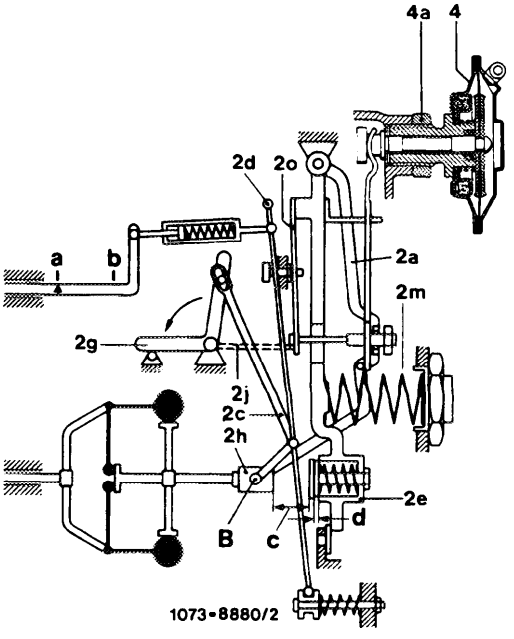
2 Governor
2a Guide lever
2b Stop screw for delivery at idle
2c Transfer lever
2d Regulating lever
2e Spring capsule (adaptation)
2f Full load adjusting screw
2g Adjusting lever
2h Sliding sleeve
2i Flyweights (pump-governor-group)
2j Idle speed auxiliary spring-shutoff
2k Adjusting screw for idle speed auxiliary spring (tickler)
2l Tensioning lever
2m Governor spring
2n Idle speed spring
20 idle speed auxiliary spring (tickler)
2p Linkage lever
2r Stop lever
2s Emergency stop lever
2t Controi rod
4 Vacuum control unit idle speed increase
4a Adjusting nut for idle speed
6 Vacuum control unit (stop)



Regulation during start and full load

If, with the engine stopped, the adjusting lever (2g) is placed against full load stop (fixed stop on governor housing), the transfer lever (2c) will swing around pivot „B'' and will take the regulating lever (2d) along in direction of start.

In full load position of adjusting lever (2g „full throttle") the idle speed auxiliary spring (2o, tickler) is forced away from guide lever under influence of idle speed auxiliary spring-shutoff (2j) A faster break away from starting position of governor will result.



a Start
b Stop
c Idle speed stage
d Adaptat ion

After running through idle speed stage (c), the sliding sleeve (2h) rests against spring capsule (2e) As a result, the control rod of the injection pump will be moved into full load position via transfer lever (2c) and regulating lever (2d).

When a given speed has been attained, excess pressure is applied to spring capsule (2e) for a given distance (d) (adaptation).

If the engine speed is still increasing, the force of the flyweights is sufficient to apply excess pressure to regulating spring (2m) (maximum speed breakaway).

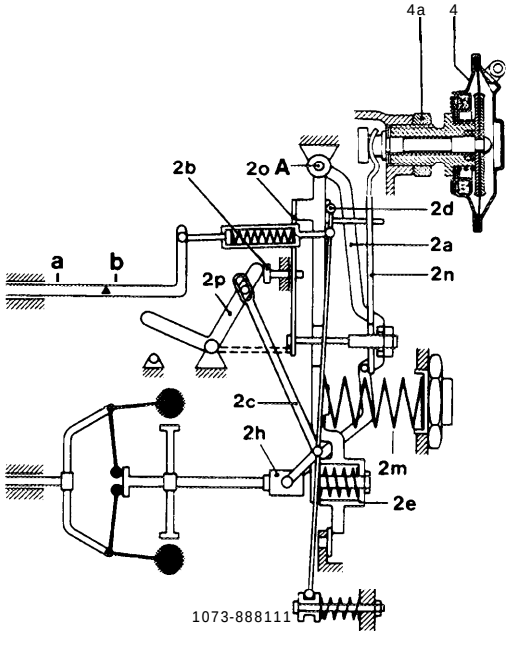
Start of breakaway depends on preload of regualting spring (2m).

Regulation at idle speed

Linkage lever (2p) rests against idle speed stop screw (2b). With increasing speed, the sliding sleeve (2h) runs through idle speed stage. Guide lever (2a) swivels around pivot ,,A" and is thereby acting against idle speed spring (2n).

At a given speed the guide lever (2a) rests against adjusting nut of idle speed auxiliary spring (20). The movement of the sliding sleeve (2h) is transmitted to control rod of injection pump via transfer lever (2c) and regulating lever (2d) in the same sense of direction. After running through idle speed stage, the sliding sleeve (2h) will rest against spring capsule (2e).

If the engine speed continues to increase (e.g. under influence of deceleration), excess pressure will first be applied to spring capsule (2e) and then to regulating spring (2m) as from a given speed. This will move the control rod into ,,stop position".



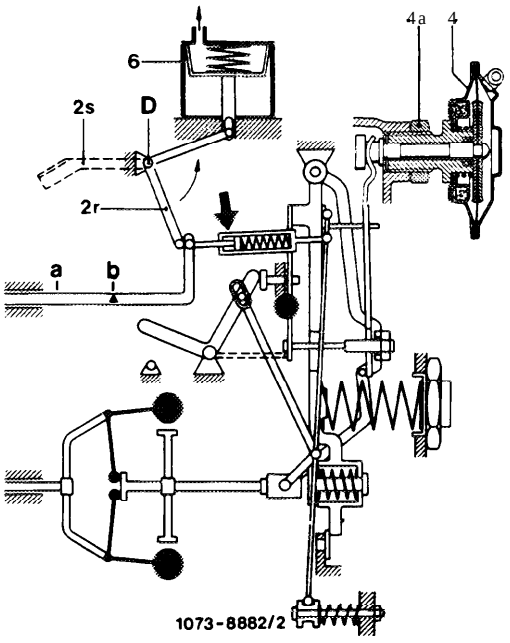
a Start
b Stop

Stop position of governor

The vacuum control unit (6) is provided with a vacuum by means of vacuum pump via steering lock of vehicle. As a result, the diaphragm of the vacuum control unit is attracted against the pressure of the diaphragm spring.

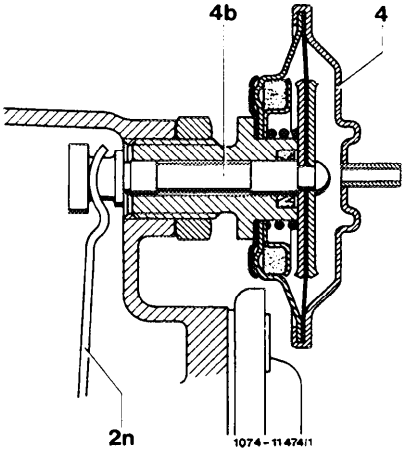
The vacuum control unit (6) is connected to a stop lever (2r). This lever will swivel around pivot „D" and will thereby pull the control rod of the injection pump into „stop position".

This will bridge the shunt spring of the regulating lever. Likewise, the control rod can be pulled from outer side of governor into „stop position" via emergency stop lever (2s).

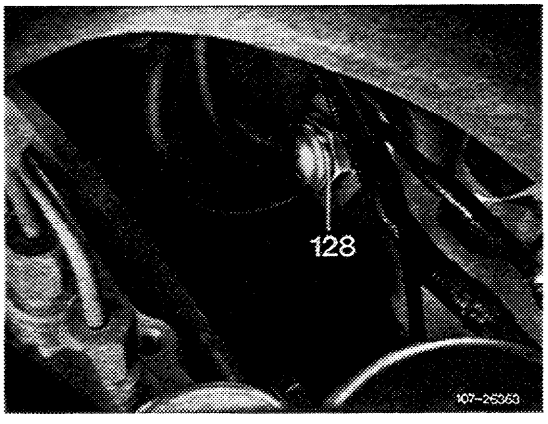


D. Pneumatic idle speed increase

Idle speed increase for rpm stabilization is effected up to approx. 17 °C coolant temperature, as well as on vehicles with automatic transmission when the refrigerant compressor is additionally connected also above approx. 17 °C coolant temperature.

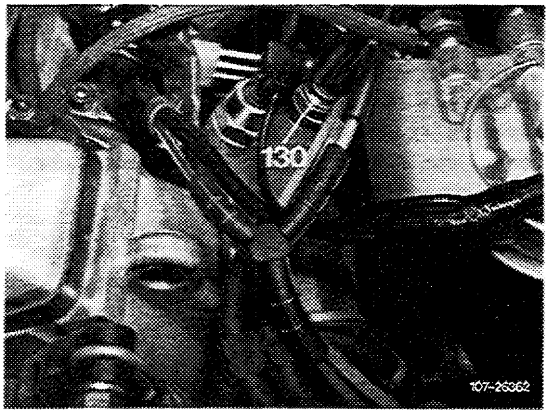


The vacuum control unit (4) attached to governor housing is activated via thermovalves (128 and 130) and switchover valve (127). If the vacuum control unit (4) is energized by a vacuum (approx. 500 mbar), the idle speed spring is attracted via plunger (4b) of vacuum control unit. The idle speed control characteristic is displaced and the idle speed is increased by approx. 100/min.



Coolant temperature < approx. 17 °C

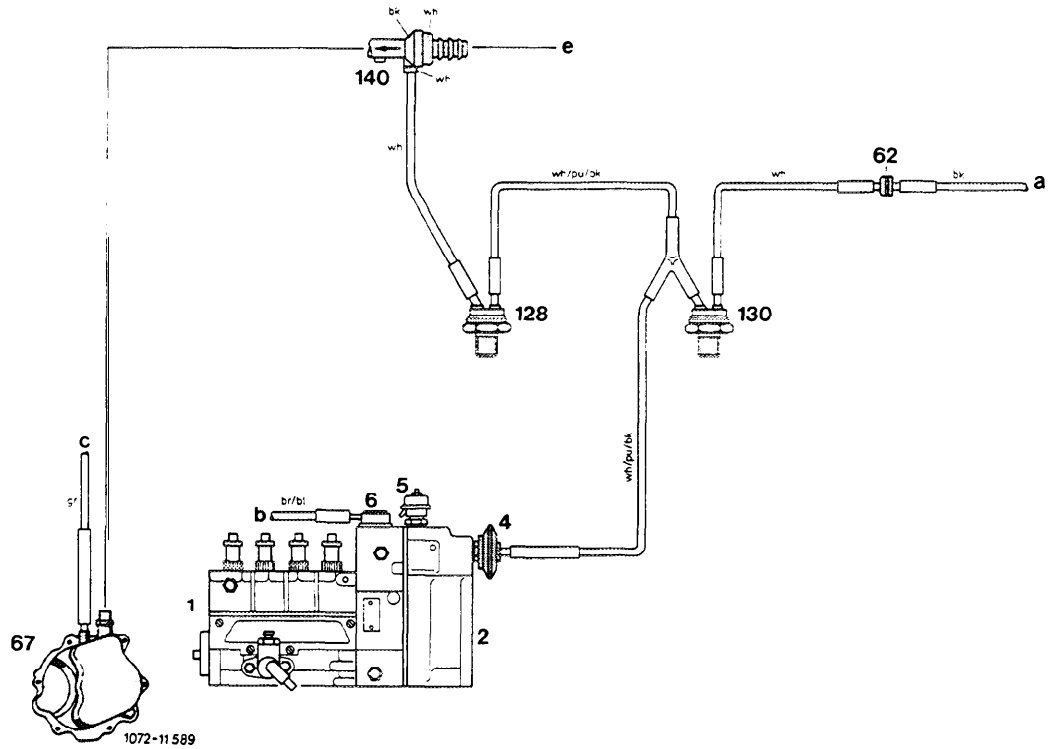
Thermovalve (128) is opened, thermovalve (130) is closed. On vehicles with automatic transmission the vacuum flows via switchover valve (127), and on vehicles with manual transmission directly to vacuum control unit (4).



Coolant temperature > approx. 17 °C

Thermovalve (128) is closed, thermovalve (130) is opened. The vacuum control unit is connected to atmosphere and the rpm increase is cancelled.

When the refrigerant compressor is additionally connected (vehicles with automatic transmission only) the switchover valve is energized and will switch. The vacuum flows through upper connection of switchover valve to vacuum control unit (4).

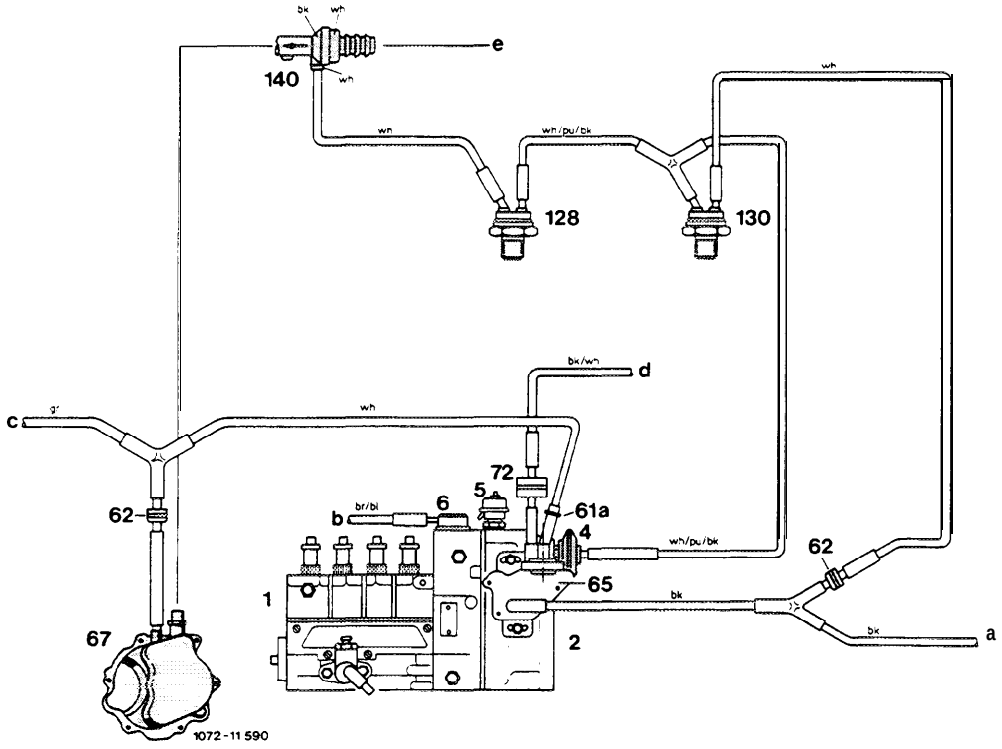


Function diagram idle speed increase with manual transmission, standard version and (USA) Federal

1 Injection pump
2 Governor
4 Vacuum control unit idle speed increase
5 ADA-capsule (altitude pressure compensator@
6 Vacuum control unit (stop)
62 Vent filter
67 Vacuum pump
128 Thermovalve closes at approx. 17 °C
130 Thermovalve opens at approx. 17 °C
140 Check valve brake unit

a Vent line to vehicle interior
b Key shutoff
c Remaining consumers
e Brake unit

bk = black
bl = blue
br = brown
gr = green
pu = purple
re = red
wh = white

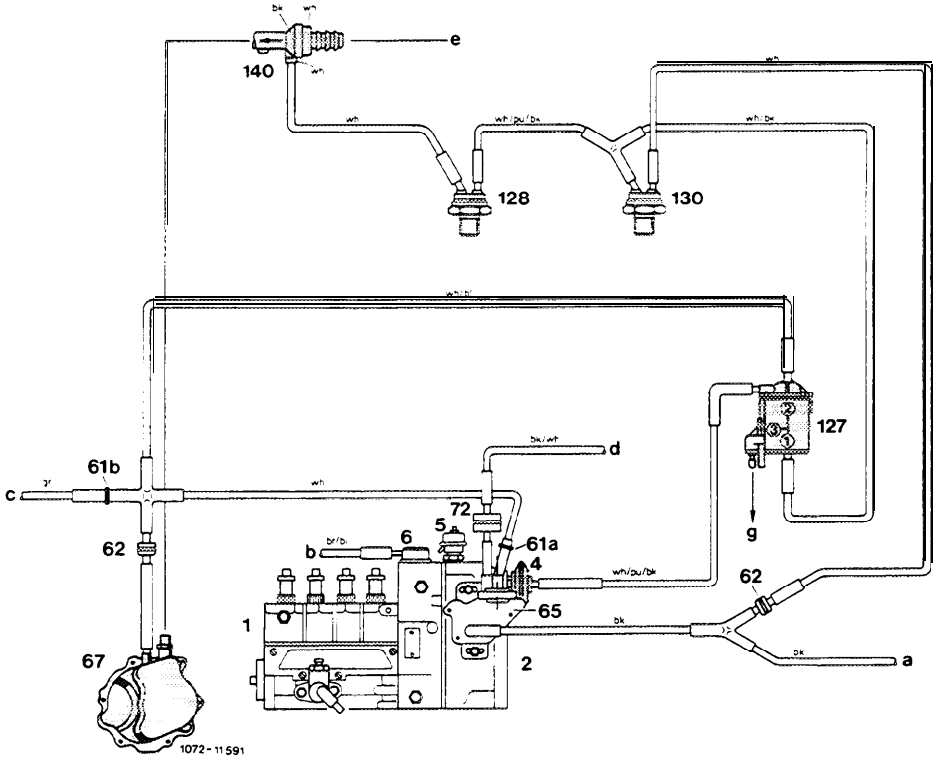


Function diagram idle speed increase with automatic transmission, standard version

1 Injection pump
2 Governor
4 Vacuum control unit idle speed increase
5 ADA-capsule (altitude pressure compensator@
6 Vacuum control unit (stop)
61a Orifice (blue)
62 Vent filter
65 Vacuum control valve
67 Vacuum pump
72 Damper
128 Thermovalve closes at approx. 17 °C
130 Thermovalve opens at approx. 17 °C
140 Check valve brake unit

a Vent line to vehicle interior
b Key shutoff
c Remaining consumers
d Vacuum control unit automatic transmission
e Brake unit

bk = black
bl = blue
br = brown
gr = green
pu = purple
re = red
wh = white

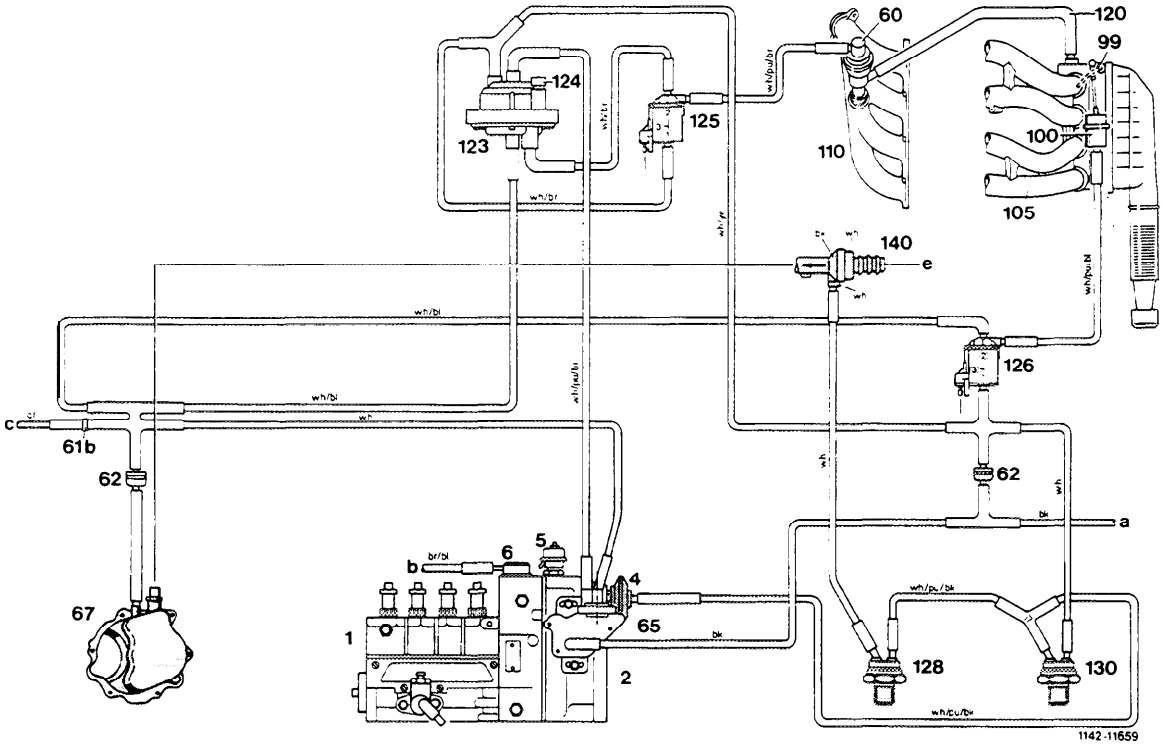


Function diagram idle speed increase with automatic transmission,@ Federal

1 Injection pump
2 Governor
4 Vacuum control unit idle speed increase
5 ADA-capsule (altitude pressure compensator)
6 Vacuum control unit (stop)
61a Orifice (blue)
61 b Orifice 0.5 mm dia. oranae
62 Vent filter
65 Vacuum control valve
67 Vacuum pump
72 Damper
127 Switchover valve, electric
128 Thermovalve closes at approx. 17 °C
130 Thermovalve opens at approx. 17 °C
140 Check valve brake unit

a Vent line to vehicle interior
b Key shutoff
c Remaining consumers
d Vacuum control unit automatic transmission
e Brake unit
g To refrigerant compressor

bk = black
bl = blue
br = brown
gr = green
pu = purple
re = red
wh = white

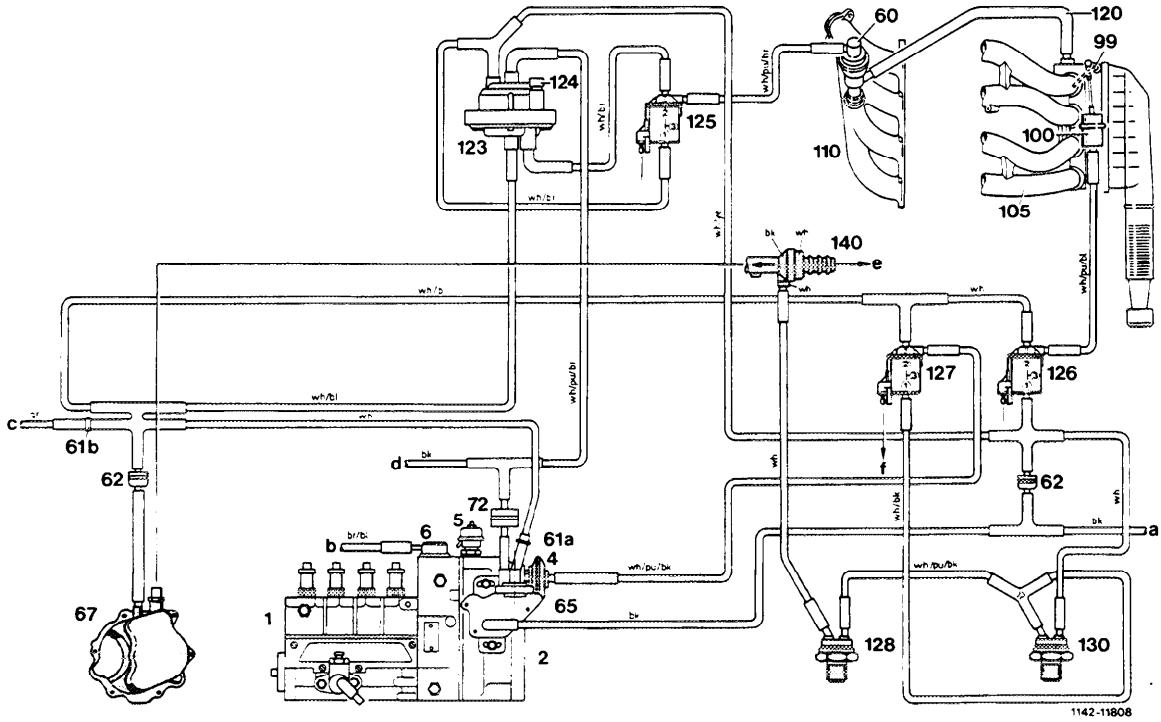


Function diagram idle speed increase with manual transmission, (USA) California

1 Injection pump
2 Governor
4 Vacuum control unit idle speed increase
5 ADA-capsule (altitude pressure compensator)
6 Vacuum control unit (stop)
60 EGR-valve
61 b Orifice 0.5 mm dia. (orange)
62 Vent filter
65 Vacuum control valve
67 Vacuum pump
99 Pressure control flap
100 Vacuum control unit for (99)
105 Intake manifold
110 Exhaust manifold
120 EGR-line
123 Pressure converter
124 Adjusting screw for (123)
125 Switchover valve electric for EGR-valve
126 Switchover valve electric for pressure control flap
128 Thermovalve closes at approx. 17 °C
130 Thermovalve opens at approx. 17 °C
140 Check valve brake unit

a Vent line to vehicle interior
b Key shutoff
c Remaining consumers
d Vacuum control unit automatic transmission
e Brake unit
f To refrigerant compressor-control unit

bk = black
bl = blue
br = brown
gr = green
pu = purple
re = red
ye = yellow



Function diagram idle speed increase with automatic transmission, (USA) California

1 Injection pump
2 Governor
4 Vacuum control unit idle speed increase
5 ADA-capsule (altitude pressure compensator)
6 Vacuum control unit (stop)
60 EGR-valve
61 a Orifice
61 b Orifice 0.5 mm dia. (orange)
62 Vent filter
65 Vacuum control valve
67 Vacuum pump
72 Damper
99 Pressure control flap
100 Vacuum control unit for (99)
105 Intake manifold
110 Exhaust manifold
120 EGA-line
123 Pressure converter
124 Adjusting screw for (123)
125 Switchover valve electric for EGR-valve
126 Switchover valve electric for pressure control flap
127 Switchover valve electric for rpm increase
128 Thermovalve closes at approx. 17 °C
130 Thermovalve opens at approx. 17 °C
140 Check valve brake unit

a Vent line to vehicle interior
b Key shutoff
c Remaining consumers
d Vacuum control unit automatic transmission
e Brake unit
f To refrigerant compressor-control unit

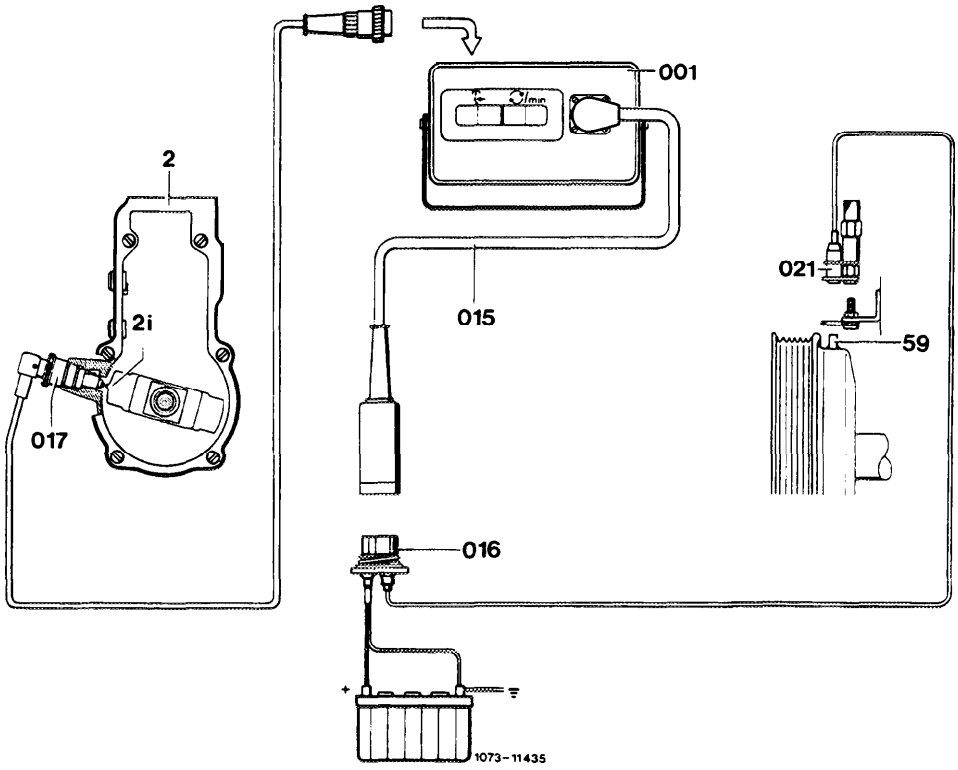
bk = black
bl = blue
br = brown
gr = green
pu = purple
re = red
ye = yellow

E. Reference impulse verification (RI V)

Measuring the association of injection pump in relation to engine requires two signals:

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

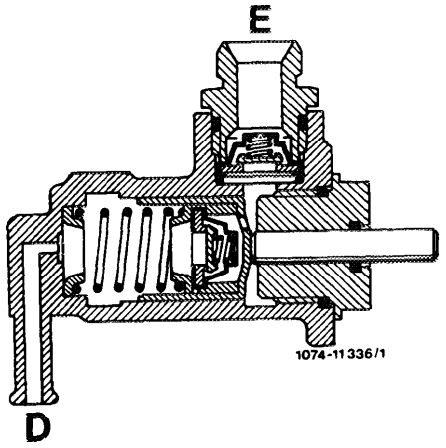
Both impulses are supplied by impulse transmitters. To obtain a measuring signal, the sensor pins must be moved past the impulse transmitters at a minimum speed (idle speed). A measuring instrument measures the chronological distance between the two impulses and converts the result into an angle value,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



001 Digital tester
2 Governor
2i Flyweight with sensor pin
015 Test cable
016 Socket
017 Reference impulse transmitter
021 TDC-impulse transmitter
059 Sensor pin

F. Fuel pump

An increased delivery capacity of fuel pump makes the fuel system self-venting. The manual delivery pump is no longer installed.

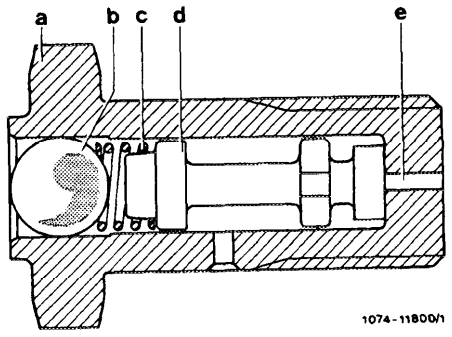


E Delivery end
D Suction end

Venting of injection pump requires an orifice in overflow valve.

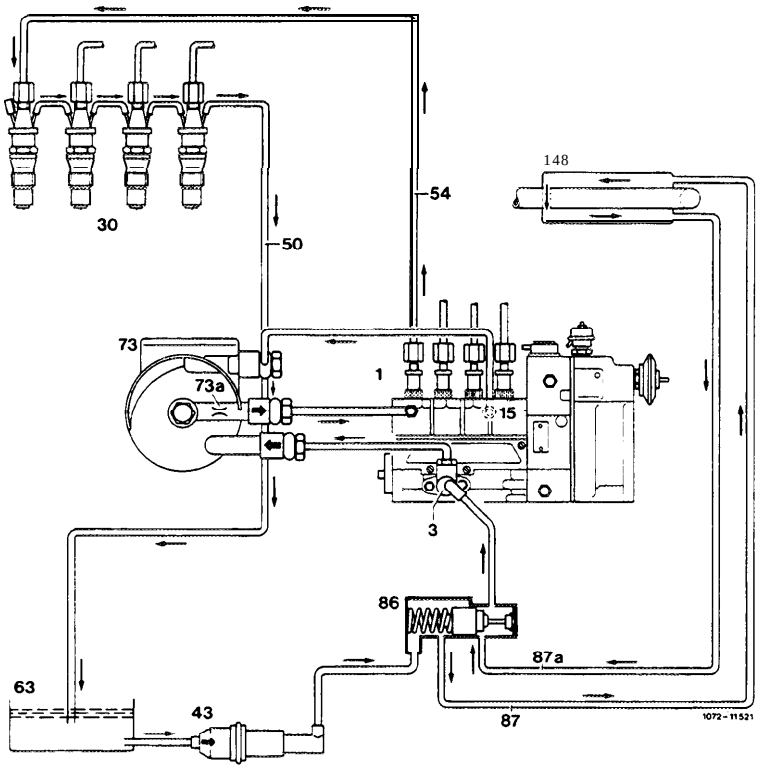
Overflow valve with 1.5 mm dia. orifice

The overflow valve prevents unfiltered fuel from entering injection pump.

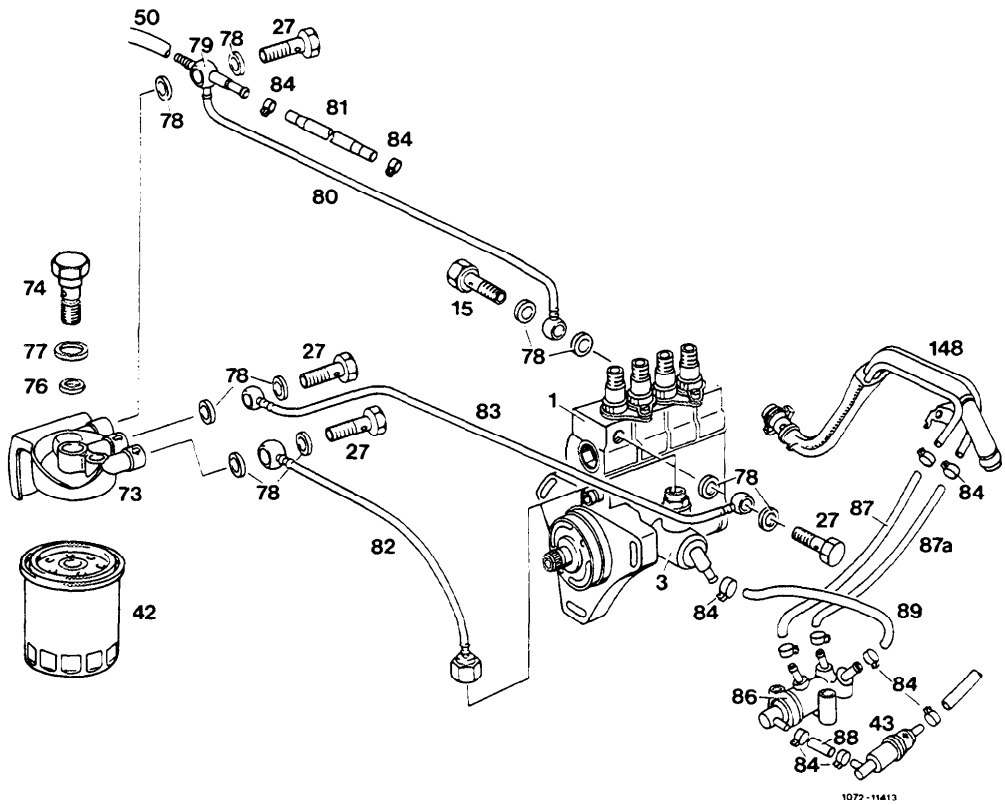


a Housing
b Ball
c Spring
d Slide
e Inlet

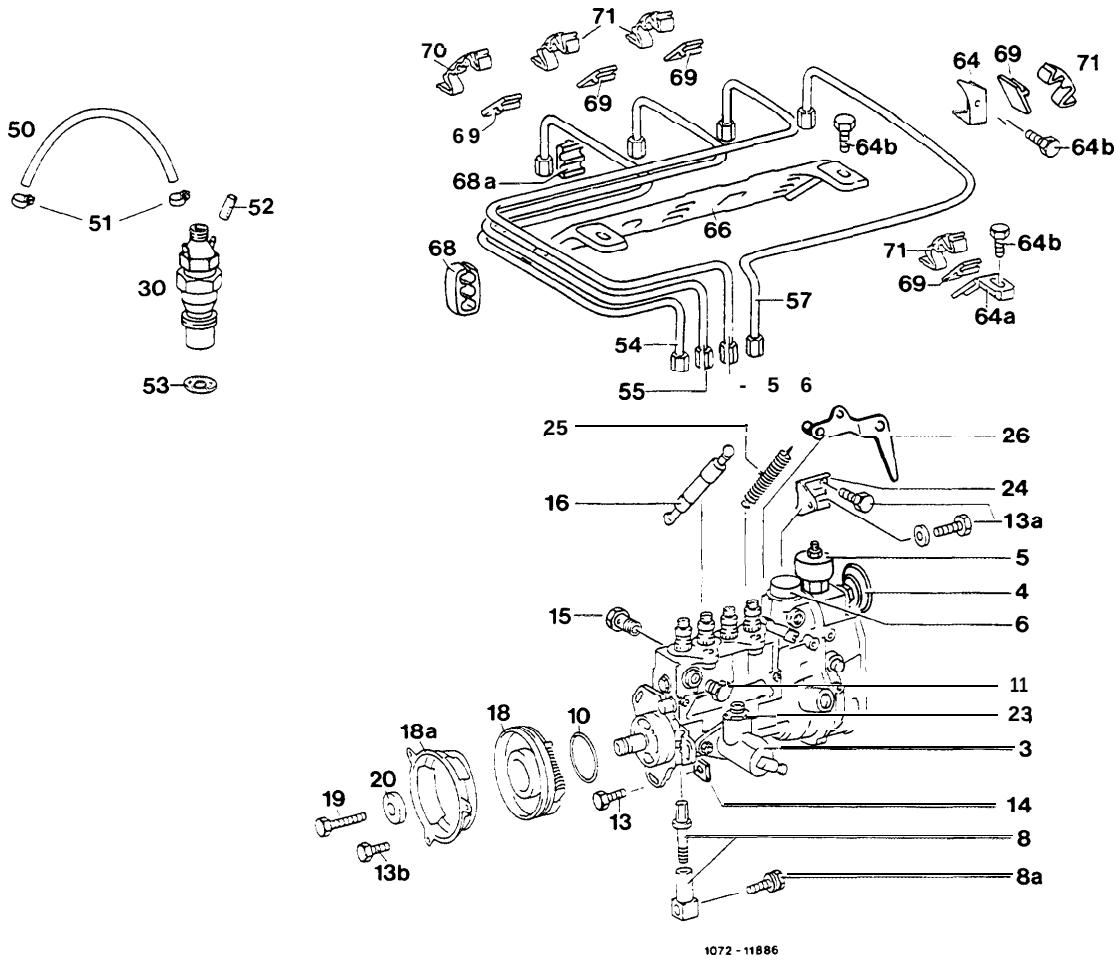
G. Function diagram low pressure circuit



1 Injection pump
3 Fuel pump
15 Overflow valve with orifice 1.5 mm dia.
30 Injection nozzles
43 Fuel prefilter
50 Leak oil hose
54 Injection line cylinder 1
63 Fuel tank
73 Fuel filter top
73a Orifice in fuel filter top 0.8 mm dia.
86 Fuel thermostat open, position up to +8°C, fuel is preheated
87 Supply line – cold fuel
87a Return line – preheated fuel
148 Heater feed line with fuel heat exchanger



Injection pump
3 Fuel pump
15 Overflow valve with orifice 1.5 mm dia.
27 Hollow screw
42 Fuel filter
43 Fuel prefilter
50 Leak oil hose
73 Fuel filter top
74 Hollow screw fuel filter
76 O-ring
77 Sealing ring fuel filter
78 Sealing ring
79 Rung-type fitting
80 Return line
81 Expanding screw
82 Inlet fuel filter
83 Inlet injection pump
84 Hose clamp
86 Fuel thermostat
87 Supply line fuel-heat exchanger
87a Return line fuel-heat exchanger
88 Supply line fuel thermostat
89 Suction line fuel pump
148 Heater feed pipe with fuel heat exchanger

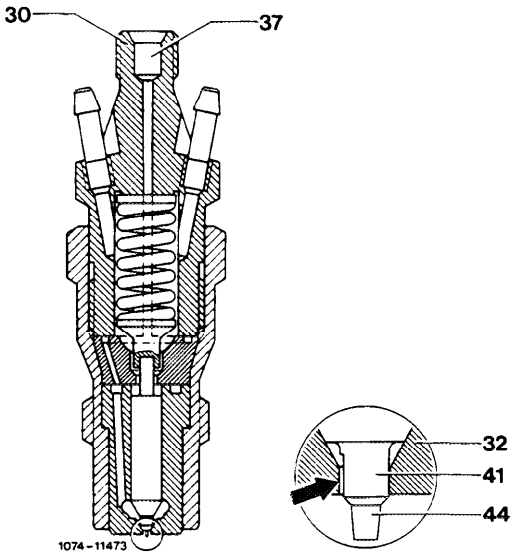


3 Fuel pump
4 Vacuum control unit idle speed increase ,,PLA''
5 ADA-capsule (altitude pressure compensator)
6 Vacuum control unit (stop)
8 Injection timing-adjusting device
10 O-ring (seal)
11 Closing plug – RIV
13 Fastening screw front
13a Fastening screw rear
13b Screw for assembly basket
14 Cage nut
15 Overflow orifice 1.5 mm dia. injection pump
16 Damper
18 Injection timer
18a Injection timer-assembly basket
19 Center fastening screw ,,lefthand threads"
20 Washer
23 Pressure connection-delivery pump
24 Holder, injection pump rear
25 Spring
26 Adjusting lever
30 Injection nozzle, complete
50 Leak oil hose
51 Hose clamp
52 Closing plug
53 Nozzle reed
54 Injection line 1
55 Injection line 2
56 Injection line 3
57 Injection line 4
64 Holder, cylinder 4, nozzle end
64a Holder, cylinder 4, pump end
64b Screw
66 Holder, lines
68 Plastic clip
68a Plastic clip
69 Rubber base
70 Plastic holder for 3 lines
71 Plastic holder for 2 lines

A. Fiat surface pintle nozzle (standard version)

Bosch designation DN 0 SD 261/-

Differs from pintle nozzle fy a flat surface (arrow) on throttle pintle (41). This will improve throttle effect.

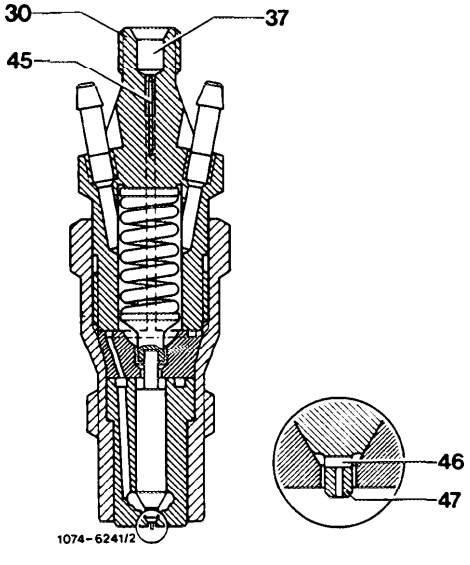


30 Injection nozzle, complete
32 Nozzle body
37 Nozzle holder top
41 Throttle pintle
44 Injection pintle

B. Hole-type pintle nozzle USA

Bosch designation DN 0 SD 240/

Differs from pintle nozzle by a transverse and lengthwise bore (46 and 47) in throttle pintle. A service-free bar filter (filter cartridge) (45) is inserted in nozzle holder top (37).

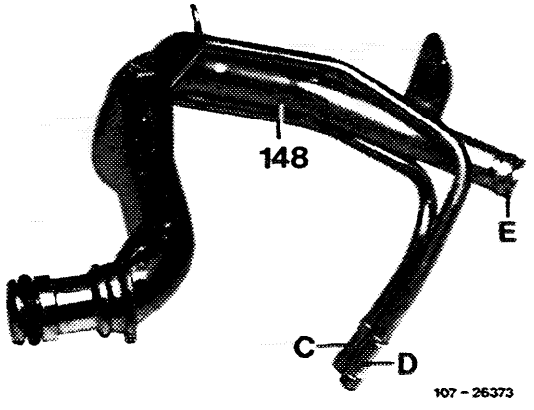


30 Injection nozzle, complete
37 Nozzle holder top
45 Bar filter (filter cartridge)
46 Transverse bore
47 Lengthwise bore

07.1-012 Operation of fuel preheater

A fuel heat exchanger (148) is installed in feed line of heater to preheat the fuel.

Full preheating up to +8 °C. The required fuel is guided through fuel heat exchanger.

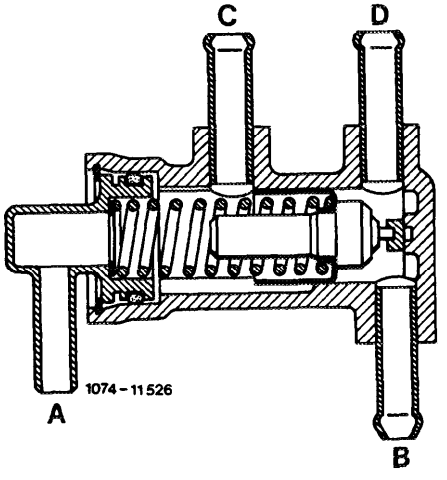


Fuel heat exchanger

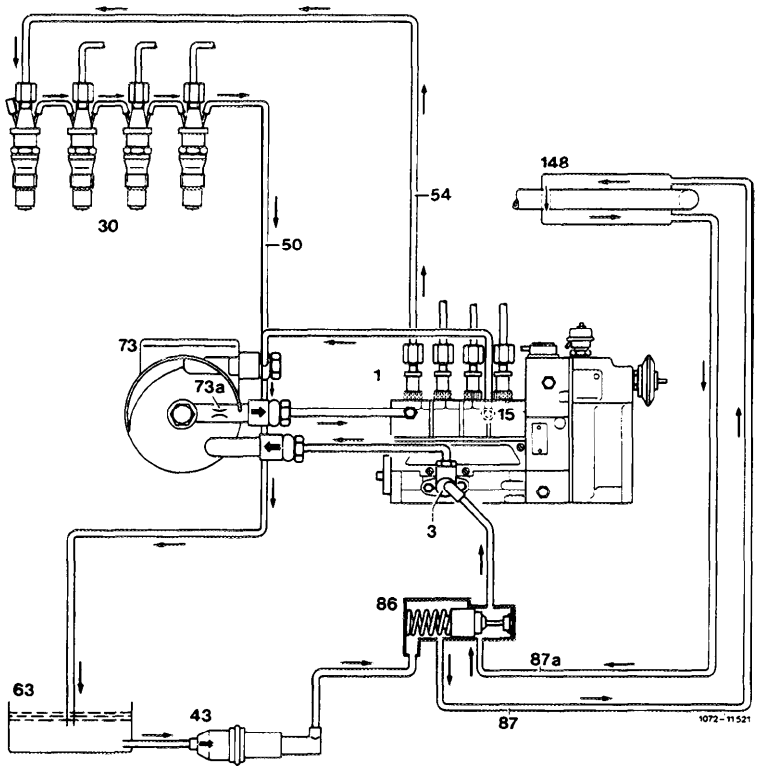
c Supply
D Return flow
E Heater feed

Mixed operation from +8 °C to +25 °C. The required fuel flows partially via fuel heat exchanger.

Above +25 °C the fuel heat exchanger is shorted by a thermostat. No more fuel will flow through fuel heat exchanger.

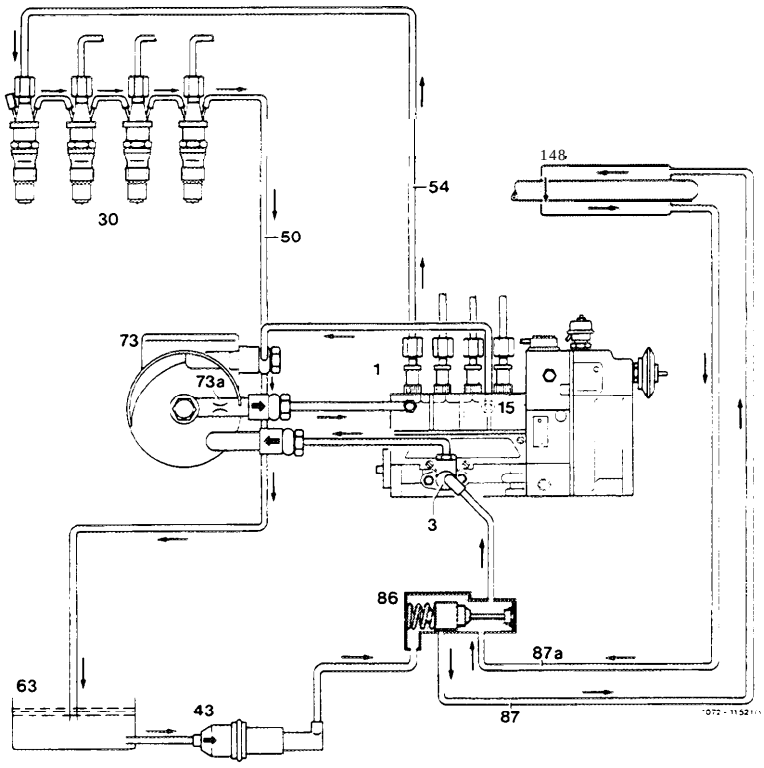


A Supply from fuel tank
B Suction line to fuel pump
C Supply to heat exchanger
D Return flow to fuel heat exchanger



Function diagram fuel preheating up to +8 °C

Injection pump
3 Fuel pump
15 Overflow valve with orifice 1.5 mm dia.
30 Injection nozzle
42 Fuel filter
42a Orifice in fuel filter top 0.8 mm dia.
43 Fuel prefilter
50 Leak oil hose
54 Injection line cylinder1
63 Fuel tank
86 Fuel thermostat
87 Supply line (cold fuel)
87a Return line (preheated fuel)
148 Fuel heat exchanger



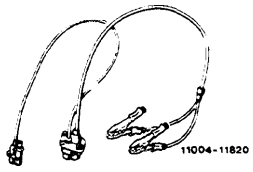
Function diagram fuel preheating above +25°C

1 Injection pump
3 Fuel pump
15 Overflow valve with orifice 1.5 mm dia.
30 Injection nozzles
42 Fuel filter
42a Orifice in fuel filter top 0.8 mm dia.
43 Fuel prefilter
50 Leak oil hose
54 Injection line cylinder 1
63 Fuel tank
86 Fuel thermostat closed
87 Supply line (cold fuel)
87a Return line (preheated fuel)
148 Fuel heat exchanger

07.1-100 Adjustment of idle speed

Job no. of work units or standard texts and flat rates data 07-2053

Test value	
Idle speed	750 ±50/min

Special tool		
TDC-impulse transmitter		601 589 04 21 00

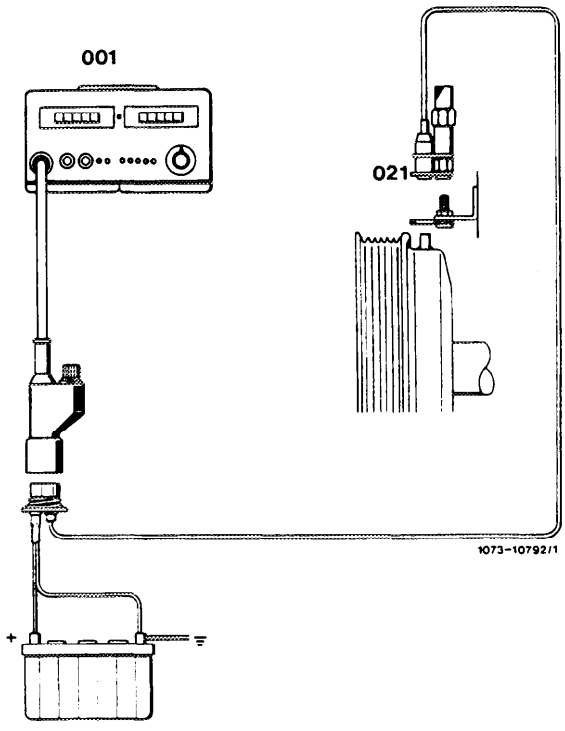
Conventional tool		
Digital tester	e.g. Bosch, MOT 001.03	
	e.g. Sun, DIT 9000	

Adjustment

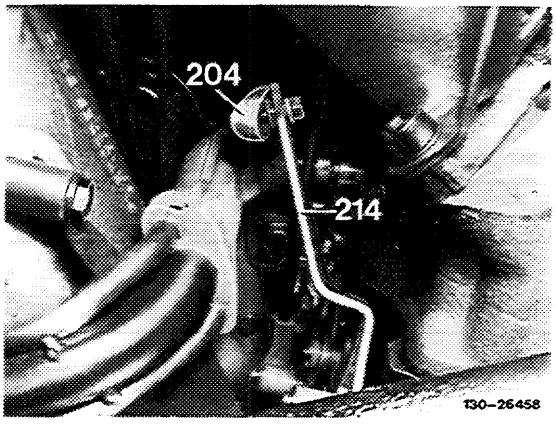
1 Connect digital tester (001) and impulse transmitter (021).

2 Check regulation for easy operation and condition.

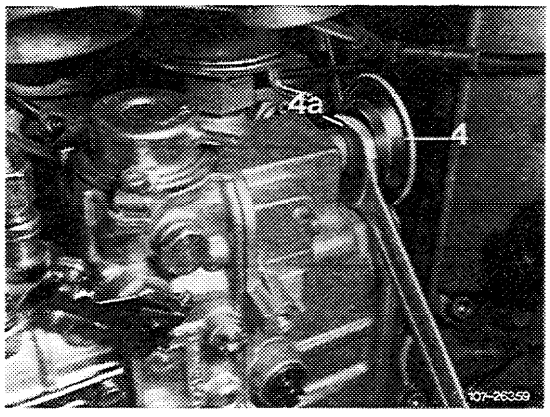
3 Run engine to 60-80 °C coolant temperature.



4 Disengage connecting rod (204) on transfer lever (214)



5 Check idle speed 750 450/min, adjust by turning vacuum control unit (4), if required, loosen counter-nut (4a) for this purpose.



6 Engage connecting rod (204) free of tension.

7 Switch on all auxiliary units and check engine for smooth running.

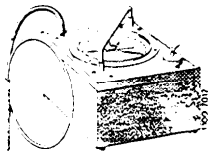
07.1-102 Checking pneumatic idle speed increase

Job no. of work units or standard texts and flat rates data 07–2009.

Test values

Idle speed increase	min 100/min at approx. 500 mbar
Permissible pressure drop of system	from 500 to 400 mbar approx. 1 min

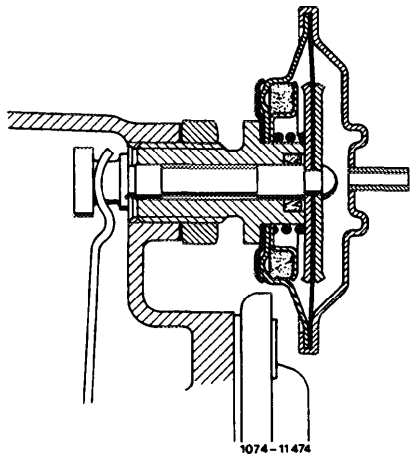
Special tool

Test unit O-1000 mbar for vacuum		116589252100

Note

Prior to performing this job, check idle speed adjustment.

Renewing of vacuum control unit on injection pump can be made at a Bosch service station only, since renewal of vacuum control unit requires disassembly of governor and subsequent adjustment on a Bosch injection pump test bench.



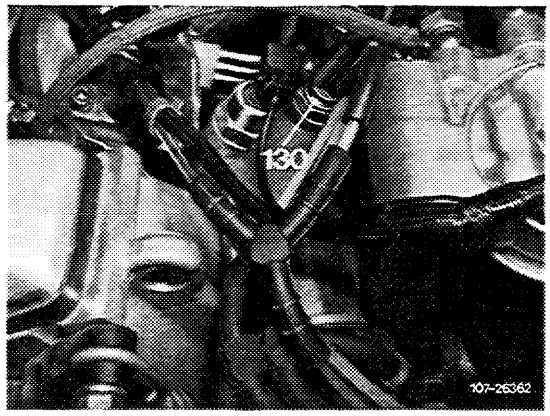
Engine at idle.

Connect vacuum tester to straight connection of thermovalve (130) and energize with 500 mbar. Engine speed increases by approx. 1 OO/min.

In order	Not in order

Check thermovalves (128 and 130). Make sure that thermovalve (128) has no passage. Thermovalve (130) must have passage. Renew thermovalve, if required.

Check vacuum lines according to function diagram.



Engine stopped.

Check vacuum control unit (4) for leaks.

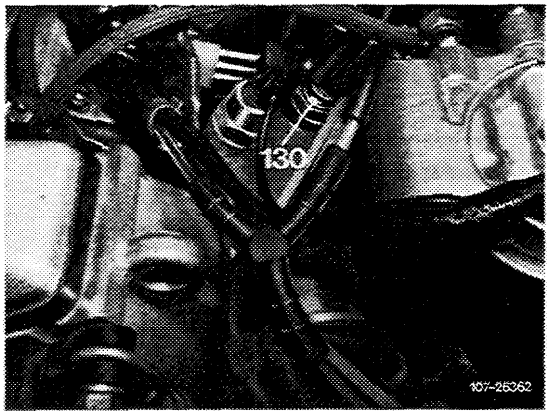
Energize vacuum tester, connection as above, with approx. 500 mbar. Vacuum value may drop approx. 100 mbar in 1 minute.

Vacuum value in order	Vacuum value not in order

Check vacuum lines and connections for damage, renew vacuum control unit, **if required.**

Check vent line for passage. Engine stops. Pull vacuum line from straight connection of thermo-valve (130) and connect with vacuum tester. Operate hand pump, but do not build up a vacuum.

Vent line in order	Vent line not in order



Renew vent filter (62), blow out vacuum line.

End of test

07.1-104 Checking engine output and exhaust gas on chassis dynamometer

Job no. of work units or standard texts and flat rates data 07-1200.

Scope

Fill in data sheet.
Check fluid levels in engine, radiator and automatic transmission.
Remove and install air cleaner cover.
Connect digital tester according to connection diagram.
Check regulating system for easy operation and for condition and lubricate.
Check full throttle stop of accelerator pedal and adjust.
Run engine oil temperature under partial load to 75-85 °C.
Check idle speed, adjust.
Check pneumatic idle speed increase.
Check max. speed under no load condition.
Check tire pressure of rear wheels.
Cool engine with blower.
Check performance – perform tachometer checkup.
Exhaust gas (emission) test under load.

Test values

Performance reference values and exhaust gas (emission) value

Engine	Rpm	Full load performance[1]) in kW (HP)		
		Manual transmission,	Automatic transmission	
	1/min	3rd speed	driving position „S"	Exhaust gas (emission) value % CO
601.911	4500	40 (54)	37 (50)	max. 0.25

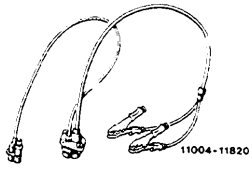
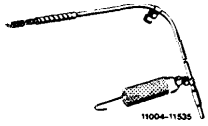
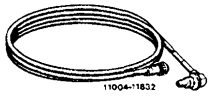
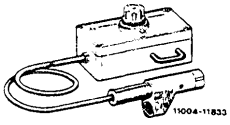
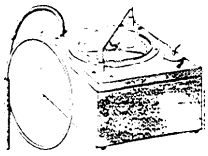
Note: During performance measurements be sure to include the different influencing factors.

[1]) **The test values are minimum performances; the permissible losses for power steering of approx. 1.5 kW(2 HP) are already deducted.**

Injection timing at 750 ±50/min	15° ±1° after TDC[2])
Idle speed	750 ±50/min
Idle speed increase min. 100/min	at approx. 500 mbar

[2]) **RI-value – indirect injection timing.**

Special tools

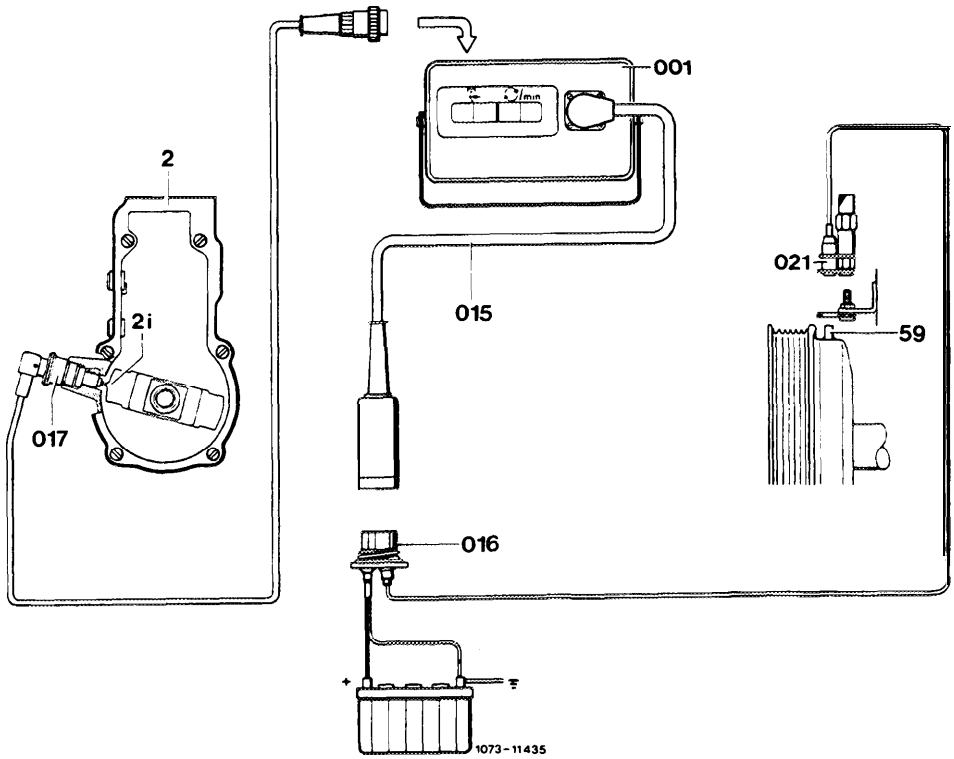
Oil telethermometer		116589272100
TDC-impulse transmitter		601 589 04 21 00
Exhaust gas probe, flexible		126 589 11 63 00
R I-transmitter		617 589 1021 00
Adapter (for available digital testers)		617 5890921 00
Tester 0–1000 mbar for vacuum		116 589 25 21 00

Conventional testers

CO-measuring instrument

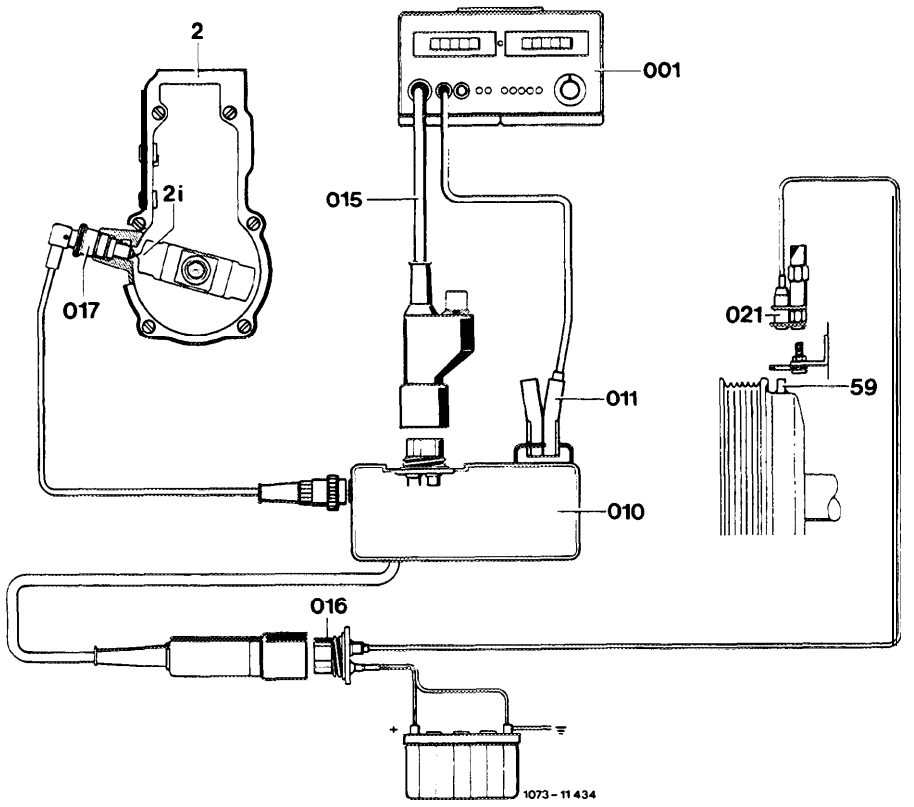
Digital testers

- e.g. Bosch, ETD 019.00
- e.g. Sun, DIT 900
- e.g. AVL, Diesel-Tester 875



**Connection diagram for test instruments without adapter,
e.g. Bosch ETD 019.00, Sun DIT 9000, AVL Diesel-Tester 875**

001 Digital tester
2 Governor
2i RI-transmitter pin
015 Test cable with plug
016 Diagnosis socket
017 R l-transmitter
021 TDC-impulse transmitter
59 TDC-transmitter pin



Connection diagram for available testers with adapter, e.g. Bosch 001.03, Hartmann & Braun EOMT 3

001 Digital tester
2 Governor
2i RI-transmitter pin
010 Adapter
011 Trigger clamp
015 Test cable with plug
016 Diagnosis socket
017 RI-transmitter
021 TDC-impulse transmitter
59 TDC-transmitter pin

Checking

1 Fill in data sheet.

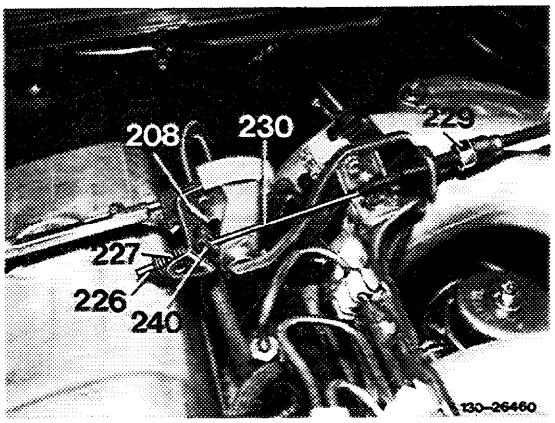
2 Check fluid levels: in engine, radiator and automatic transmission and correct, if required.

3 Remove and install air cleaner cover.

4 Connect digital tester according to connection diagram.

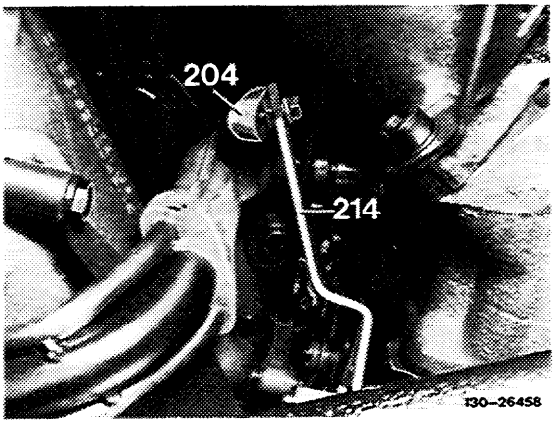
5 Check ragulating system for easy operation and condition and lubricate.

6 Check full throttle stop from direction of accelerator pedal, adjust by means of adjusting screw (229), if required.



7 Run engine oil temperature under partial load to 75-85 °C.

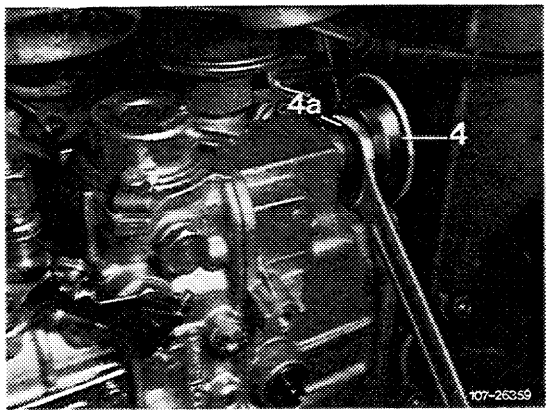
8 Disengage connecting rod (204) on transfer lever (214).



9 Check idle speed 750 ± 50/min, adjust by turning vacuum control unit (4), if required, loosen counternut (4a) for this purpose.

Engage connecting rod (204) free of tension.

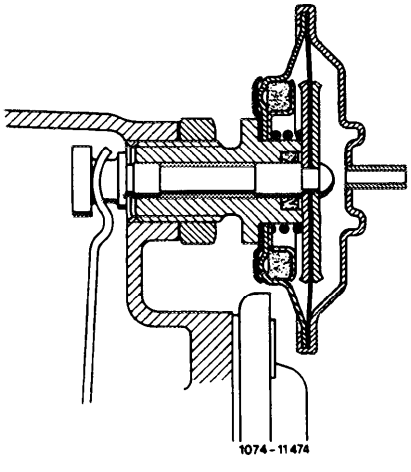
Switch on all auxiliary units and check engine speed.



10 Check pneumatic idle speed increase:

Attention!
Prior to performing this job, check idle speed adjustment.

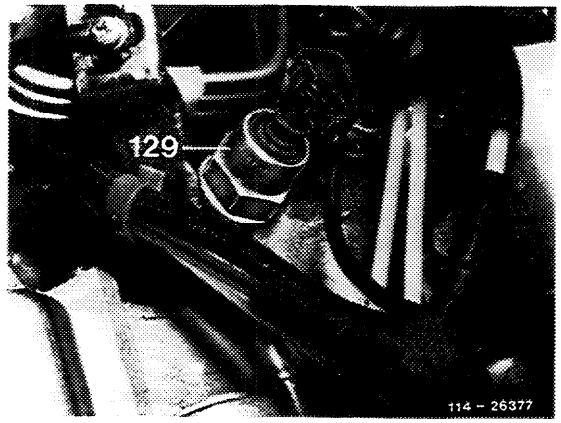
The vacuum control unit for idle speed increase on injection pump can be renewed only with injection pump removed.



Engine at idle.

Connect vacuum tester to straight connection of thermovalve (130) and energize with 500 mbar. Engine speed increases by approx. 100/min, check pneumatic idle speed increase, if required (07.1-102).

Note: The vacuum control unit idle speed increase on injection pump can be renewed only with injection pump removed.

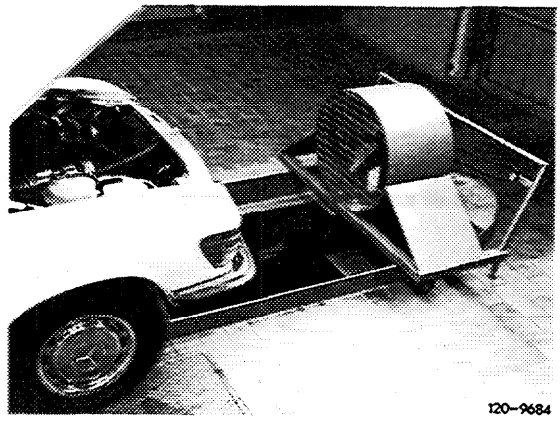


11 Secure front wheels. For this purpose, place chocks at a distance of approx. 100 mm in front of front wheels.

12 Check tire pressure of rear wheels and correct, if required.

13 Check trunk contents, remove heat-sensitive items.

14 Cool engine with blower.



15 Check full load performance.

Attention!
Run at full load only as long as required for reading the instruments.

16 Check exhaust gas (emission) value under load.

If the specified exhaust gas values under load cannot be attained in spite of fully including idle speed emission value tolerance, set injection pump on pump test bench to upper tolerance limit.

07.1-109 Checking injection timing (high-pressure method)

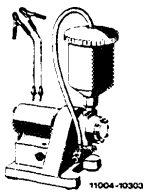
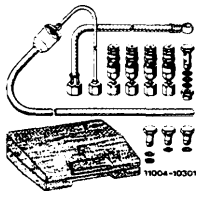
Job no. of work units or standard texts and flat rates data 07-8234.

Test value	
Injection timing	In compression stroke 24° before TDC

Attention!
While measuring, move regulating lever of injection pump to full load and pull off vacuum hose at vacuum control unit „Stop".

Tightening torque (reference value)	Nm
Injection line	1 O-20

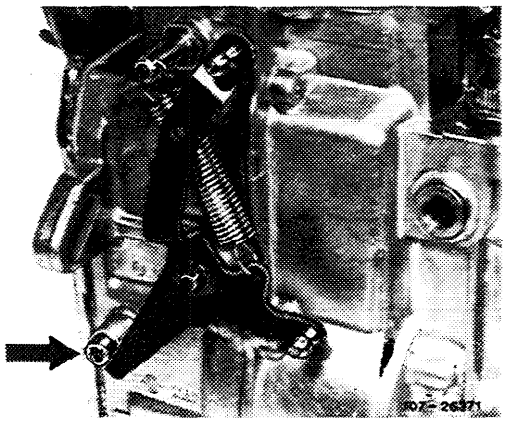
Special tools

Pump unit, complete		617589007100
Connecting parts with storage case		617589009100
Quick lock		617589029100
Torque wrench with plug-in ratchet, 1/2" square, 25-l 30 Nm		001589662100
Box wrench element, open, 14 mm, 1/4" square for injection lines		000589770300
Socket wrench element 27 mm, 1/2" square		001589650900

Testing

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.



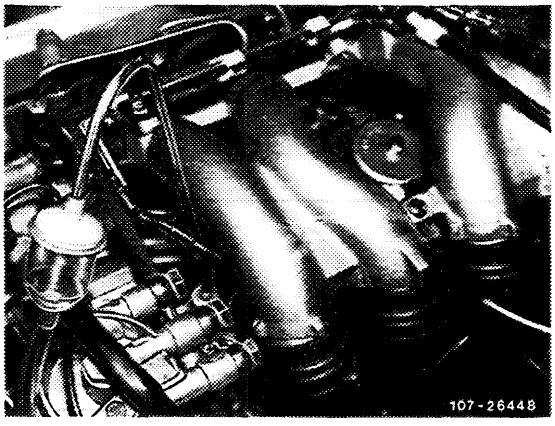
Adjusting lever on full load stop

3 Completely remove air cleaner.

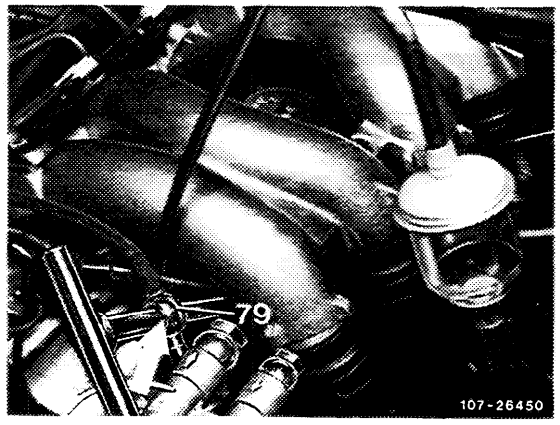
4 Pull off vacuum line on stop capsule.

5 Unscrew injection line from cylinder 1.

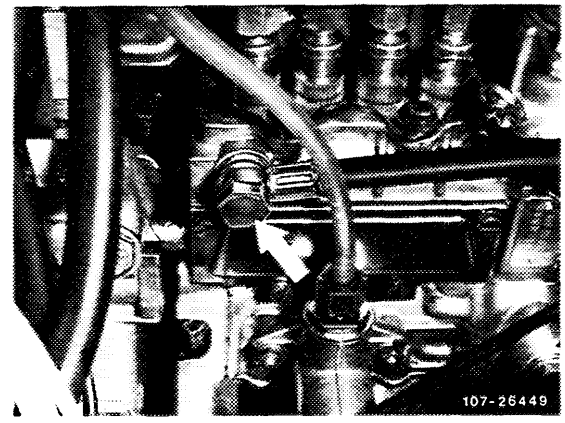
Screw test line with sight glass to injection pump and install return flow line to fuel tank of pump unit.



6 Close fuel return line from injection pump to fuel filter. Insert O-ring into ring fitting (79) of return flow line and firmly press in quick lock (arrow).



7 Connect supply line from pump unit to injection pump supply (arrow).



8 Connect connecting cable of pump unit to vehicle battery (red terminal positive, black terminal nagative).

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

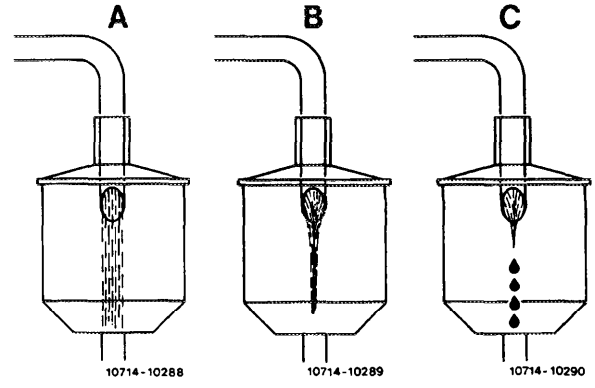
Attention!
Engage pump unit for measuring only. If an injection nozzle is leaking, fuel may enter combustion chamber.

10 Rotate crankshaft slowly in direction of rotation of engine while watching fuel jet in sight glass.

If fuel jet changes to chain-like drops, start of delivery (injection timing) has been attained.

In this position, read begin of delivery (injection timing) on graduated scale on belt tension.

Nominal value: 24° before TDC.

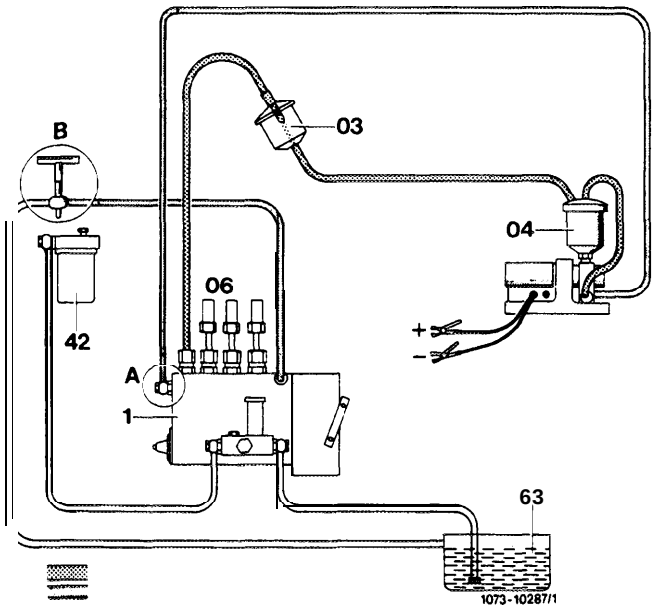


A Fuel jet, full
B Fuel jet, restricted prior to begin of delivery
C Chain-like drops begin of delivery

11 Disconnect pump unit. Assemble injection system. Mount air cleaner.

Note: When engine is started, the injection system will vent itself automatically.

12 Run engine and check all connections for leaks.



Connection diagram high-pressure overflow method

Return flow line
High-pressure approx. 34 bar

1 Injection pump
03 Sight glass
04 Pump unit
06 Pressure limiting valves (not required)
42 Fuel filter
63 Fuel tank

A Hollow screw, fuel supply from pump unit
B Fuel return flow line closed with quick lock or clamp

07.1-111 Checking injection timing (position pickup-RIV-method)

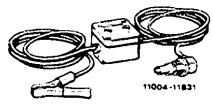
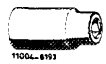
Job no. of work units or standard texts and flat rates data 07-8240.

Test values

	Test value	Adjusting value
RI-value (indirect injection timing)	15 ±1° after TDC	15° after TDC

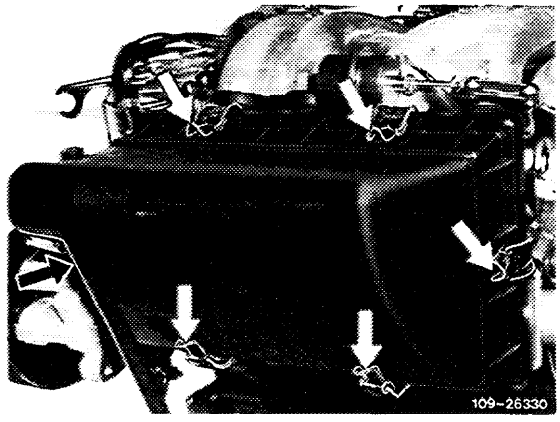
Tightening torques (reference values)	Nm
Closing plug on governor (measuring point)	30-35
Injection lines	1 O-20
Injection pump flange	20-25

Special tools

Torque wrench with plug-in ratchet, 1/2'' square, 25-130 Nm		001 5896621 00
Position indicator		617 589 08 21 00
Socket wrench element 27 mm, 1/2'' square		001 589 65 09 00

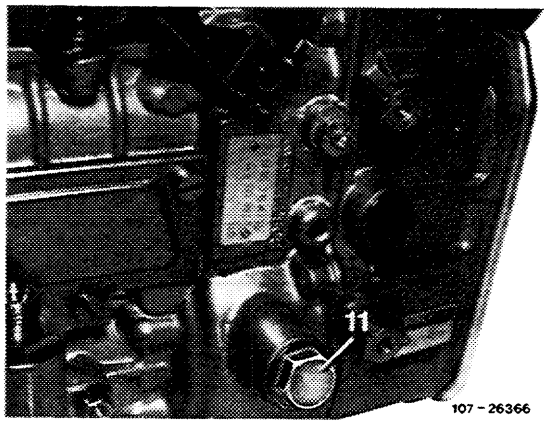
Checking

1 Remove air cleaner top (arrows).

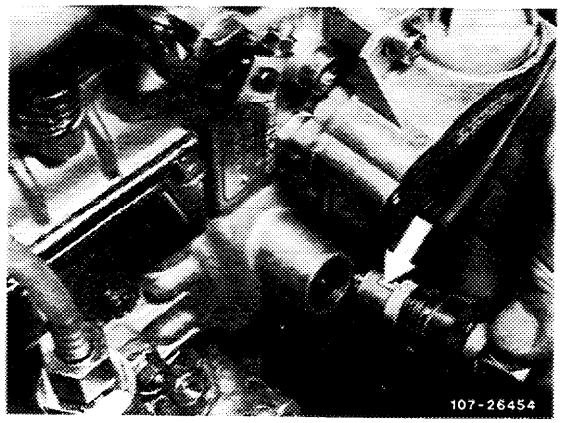


2 Remove closing plug (11).

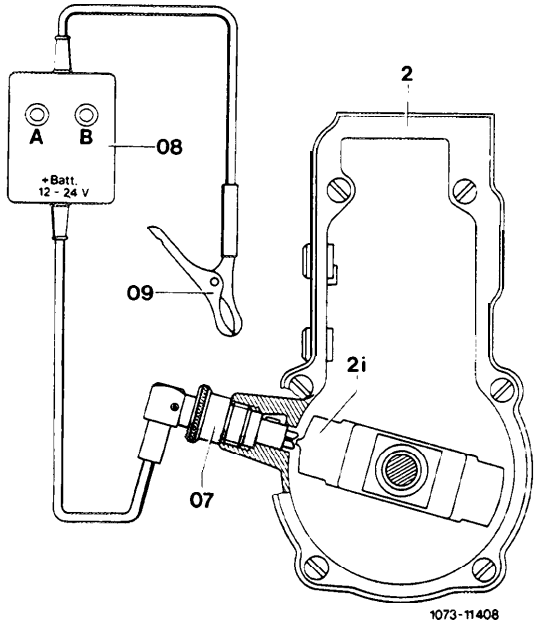
Attention!
Attach emerging oil.



3 Screw position indicator into governor housing. Make sure that the guide pin of positioning indicator (arrow) is extending in upward direction. Tighten coupling nut manually.



4 Connect position indicator according to connection diagram.

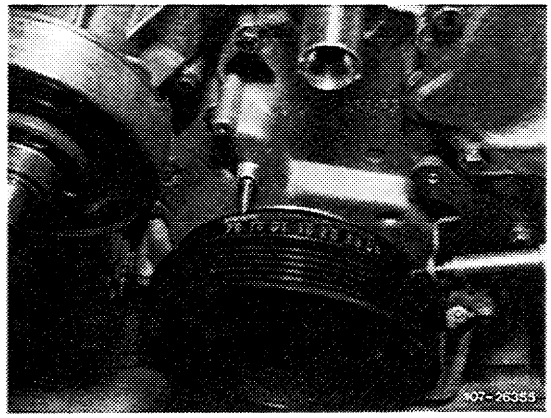


07 Position indicator
0 8 Indicator
09 Battery terminal (battery positive)

5 Rotate crankshaft with tool manually (in direction of rotation only), until lamp ,,A" lights up. Carefully continue rotating crankshaft until **both lamps** are lighting up ,,A + B". In this position, read RI-value (indirect injection timing) on graduated disk.

Nominal value: 15° after TDC

If only lamp ,,B" ist lighting up, repeat test.



6 Remove position indicator.

7 Screw in closing plug.

8 Mount air cleaner top.

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-I 12 Checking injection timing with digital tester (RIV-method)

Job no. of work units or standard texts and flat rates data 07-8244.

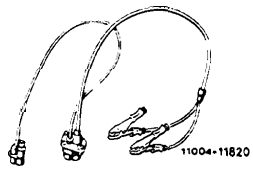
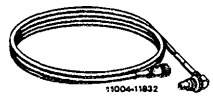
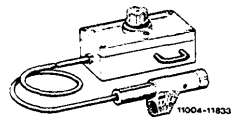
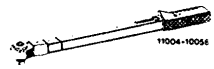
Test values

Rpm	750 ±50/min
RI-adjusting value[1])	15° after TDC
R I-test value	15° ±1° after TDC

[1]) Indirect injection timing.

Tightening torques (reference values)	Nm
Closing plug on governor (measuring point)	30-35
Injection pump flange	20-25

Special tools

TDC-impulse transmitter		601 589042100
R I-transmitter		617589102100
Adapter (for available digital testers)		617689092100
Torque wrench with plug-in ratchet, 1/2'' square, 25-I 30 Nm		001 589 66 21 00

Conventional tools

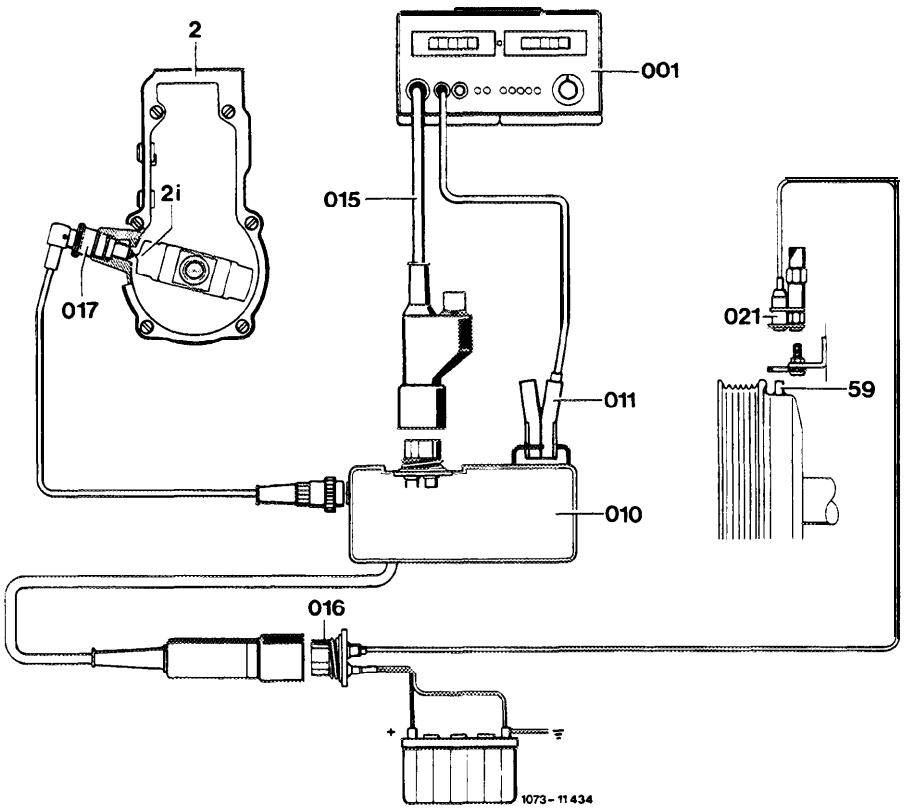
Application with adapter

Digital testers	e.g. Bosch, MOT 001.03
	e.g. Hartmann & Braun, EOMT 3

Application without adapter

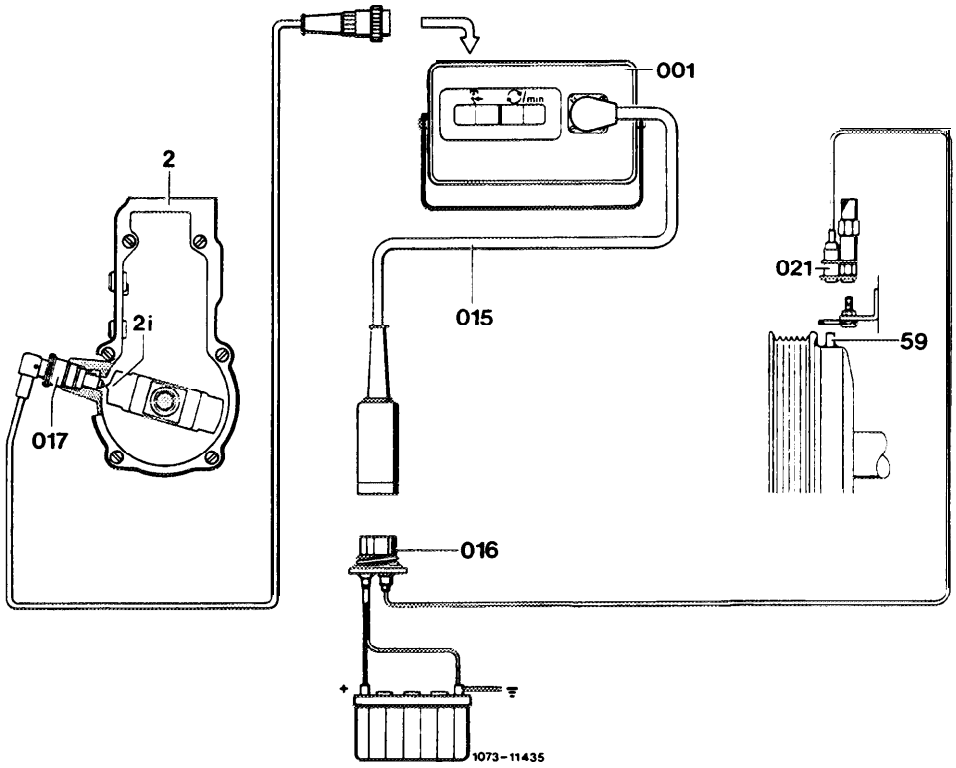
Digital testers	e.g. Bosch, ETD 019.00
	e.g. Sun, DIT 900
	e.g. AVL, Diesel-Tester 875

Connection diagram for available testers with adapter,
e.g. Bosch MOT 001.03, Hartmann & Braun EOMT 3



001 Digital tester
010 Adapter
011 Trigger clamp
015 Test cable with plug
016 Diagnosis socket
017 RI-transmitter
021 TDC-impulse transmitter
2 Regulator
2i RI-transmitter pin
59 TDC-transmitter pin

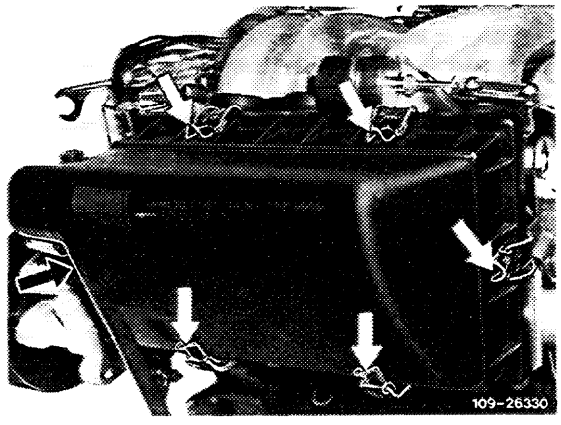
Connection diagram for testers without adapter,
e.g. Bosch ETC 019.00, Sun DIT 9000, AVL Diesel-Tester 875



2 Regulator
2i RI-transmitter pin
001 Digital tester
015 Test cable with plug
016 Diagnosis socket
017 R I-transmitter
021 TDC-impulse transmitter
59 TDC-transmitter pin

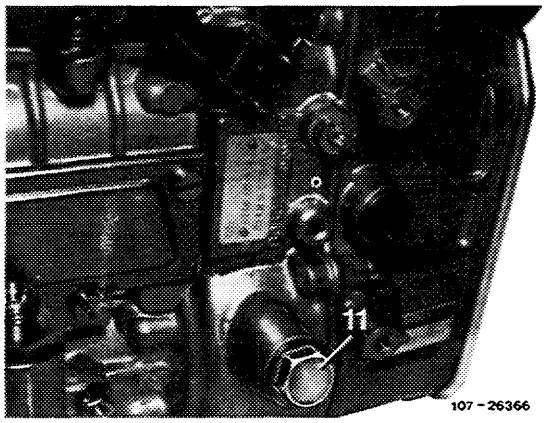
Checking

Remove air cleaner cover (arrows),

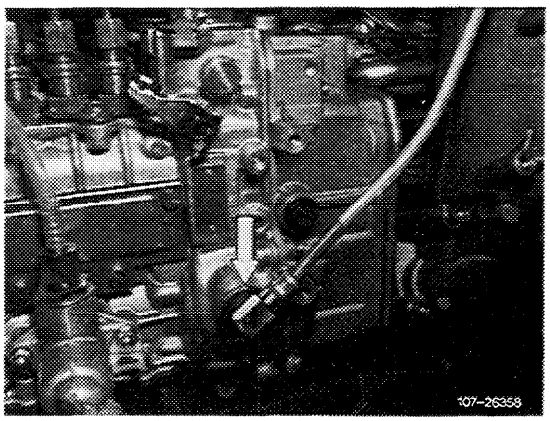


2 Remove closing plug from regulator.

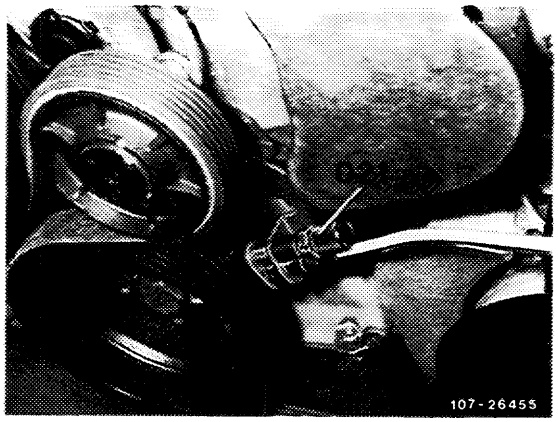
Attention!
Catch emerging oil.



3 Connect digital tester accord **ing to** connection diagram.



017 RI-transmitter on regulator (injection pump)



021 TDC-impulse transmitter on holder (engine)

4 Engine at idle. Read TI-value (indirect injection timing) at idle speed 750 ± 50/min on digital tester.

RI-nominal value: 15° after TDC at 750 ± 50/min.

5 Stop engine.

6 Disconnect digital tester.

7 Screw in closing plug on regulator.

8 Mount air cleaner top.

9 Perform leak test with engine running.

10 Check engine oil level, and correct, if required.

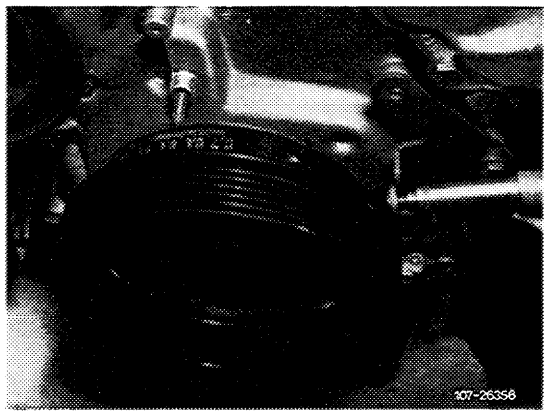
07.1-I 15 Adjusting injection timing (high-pressure method) — following checkup

Job no. of work units or standard texts and f tat rates data 07—8300.

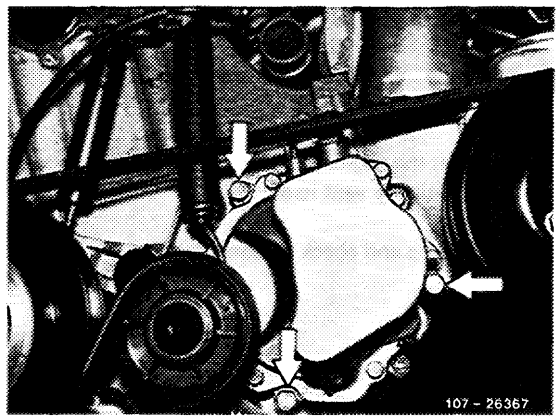
Note

Prior to adjustment, check injection timing on cylinder 1 (07.1-109).

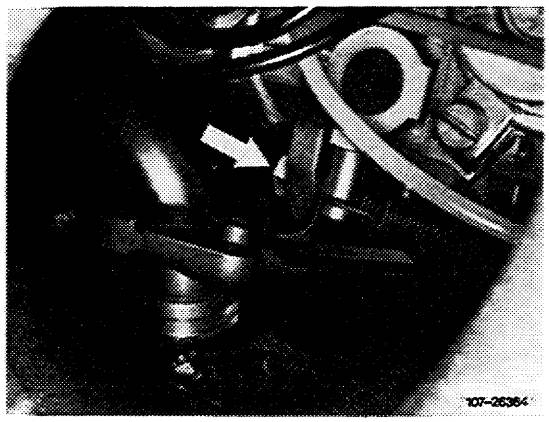
Adjusting



1 Set crankshaft in direction of roation to 24° before TDC in compression stroke of 1st cylinder.



2 Loosen fastening screws (arrows) on injection pump flange and on supporting holder (arrow).

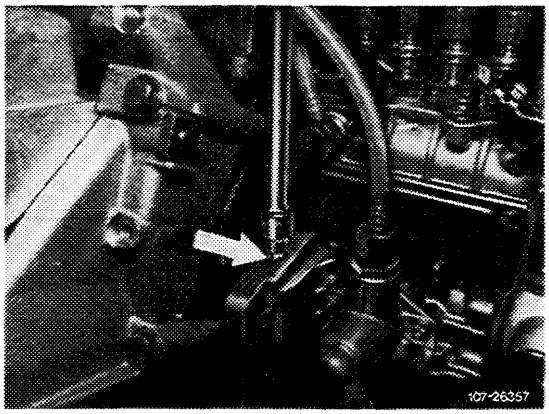


Fastening of supporting holde

3 Engage pump unit.

4 Swivel injection pump by turning adjusting screw on adjusting device, while watching fuel jet. If the fuel jet changes to chain-like drops, begin of delivery (injection timing) has been attained.

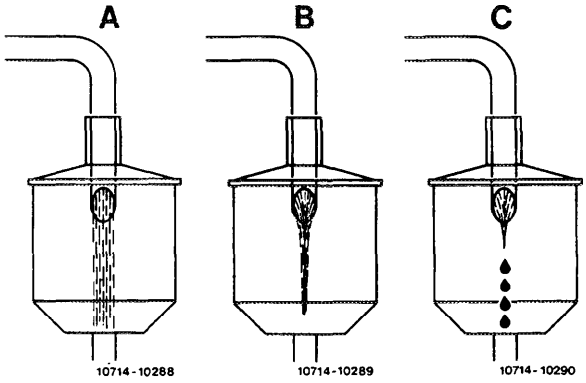
Nominal value: 24° before TDC.



Direction of rotation of adjusting screw

Clockwise = injection timing retarded
Counterclockwise= injection timing advanced

Note: If adjustment cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).



A Fuel jet full
B Fuel jet restricted
shortly before begin of delivery (injection timing)
C Chain-like drops begin of delivery (injection timing)

5 Disconnect pump unit.

6 Assemble injection system and check regulating linkage, adjust, if required (30-300).

Note: When the engine is started, the injection system will automatically vent itself.

7 Run engine and check all connections for leaks.

07.1-I 16 Adjusting injection timing (position pickup-RIV-method) — following checkup

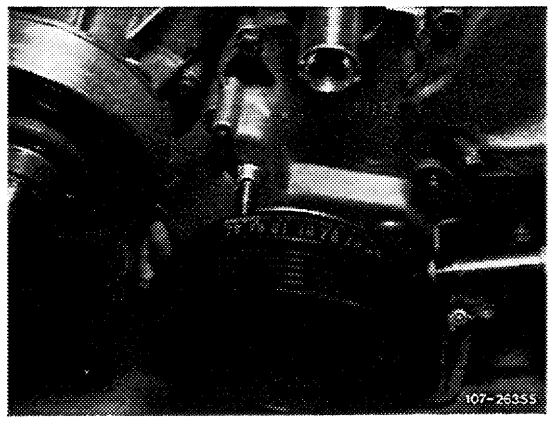
Job no. of work units or standard texts and flat rates data 07–8300.

Note

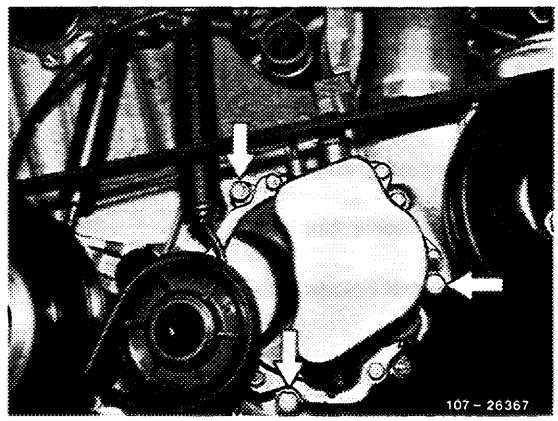
Prior to making adjustments, check begin of delivery (injection timing) (07.1-I 11).

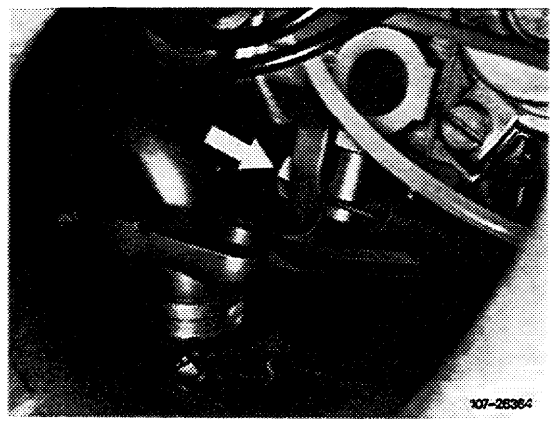
Adjustment

1 Set crankshaft in direction of rotation to 15° after TDC of first cylinder.



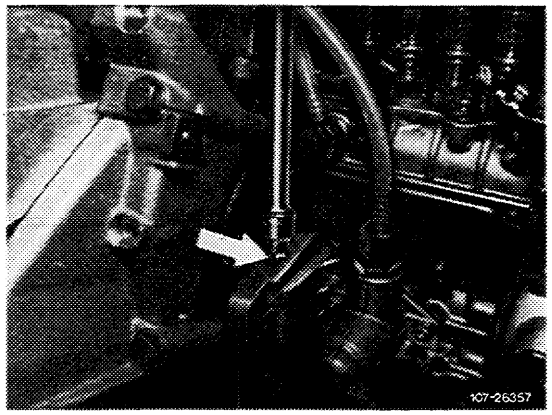
2 Loosen fastening screws (arrows) on injection pump flange and on supproting holder (arrow).





Screw on supporting holder

3 Swivel injection pump by turning adjusting screw on injection timing-adjusting device until both lamps are lighting up.



Direction of rotation of adjusting screw

Clockwise = injection timing retarded
Counterclockwise = injection timing advanced

RI-nominal value 15^{o} after TDC.

Note: If adjustment cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).

4 Tighten fastening screws on injection pump flange and on supporting holder.

5 Remove position indicator (position pickup).

6 Screw in closing plug.

7 Mount air cleaner top.

8 Check control linkage and adjust, if required (30–300).

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-I 17 Adjusting injection timing with digital tester(R IV-method) – following checkup

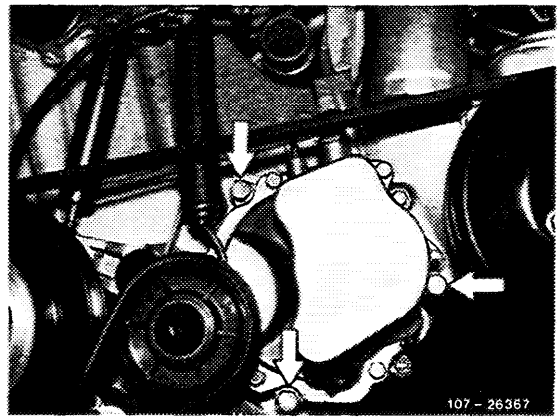
Job no. of work units or standard texts and flat rates data 07-8300.

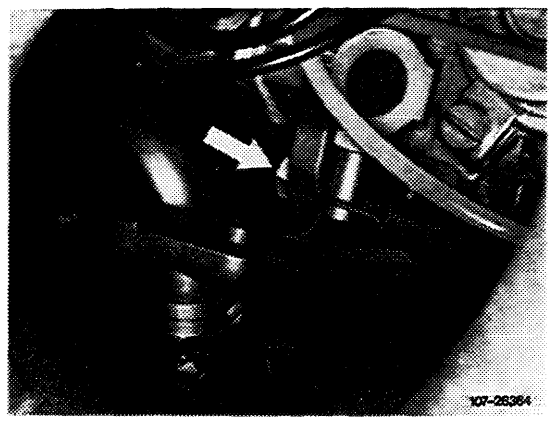
Note

Prior to making adjustments, check begin of delivery (injection timing) (07.1-I 12).

Adjusting

1 **Loosen fastening screws (arrows) on injection pump flange as well as on supporting holder (arrow).**





Screw on supporting holder

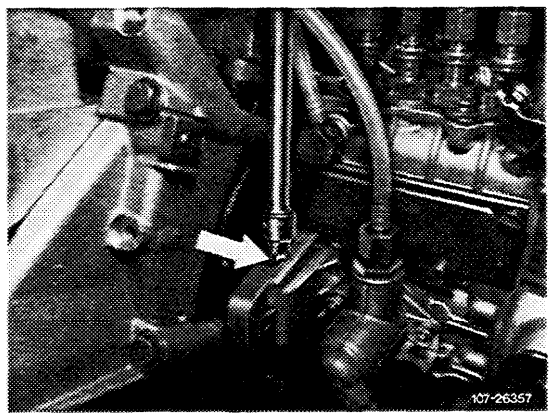
2 **Run engine at 750 ± 50/min at idle.**

3 Adjust RI-value (indirect injection timing) by turning adjusting screw on injection timing-adjusting device.

RI-nominal value: 15° after TDC at 750 ± 50/min.

Direction of rotation of adjusting screw

Clockwise = injection timing retarded
Counterclockwise = injection timing advanced



Note: If adjustments cannot be made any further, displace injection pump. Removal and installation of injection pump (07.1-200).

4 Stop engine.

5 Disconnect tester.

6 Screw in closing plug on regulator.

7 Mount air cleaner.

8 Check control linkage and adjust, if required (30–300).

9 Perform leak test with engine running.

10 Check engine oil level and correct, if required.

07.1-135 Checking injection nozzles

Job no. of work units or standard texts and flat rates data 07-6712.

Injection nozzles removed (07.1-230).

Test values

Injection nozzle	new	used
Opening pressure in bar	115-125	min. 100

Special tool

Cleaning unit		000 589 00 68 00

Conventional tools

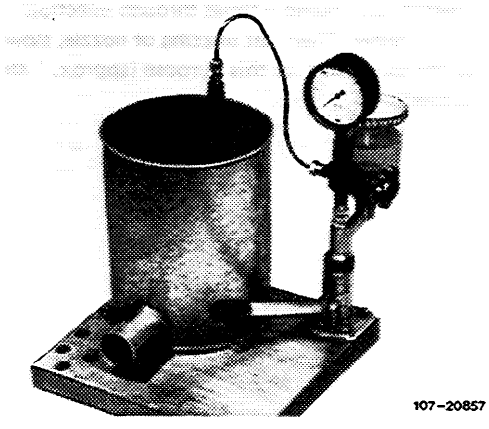
Tester EFEP 80 H	e.g. Bosch, D-7000 Stuttgart order no. 0 881 200 502
Cleaning needle 0.18 mm dia.	e.g. Bosch, D-7000 Stuttgart order no. KDEP 2900/4

Note

For testing, use clean test oil or filtered diesel oil only. When checking a nozzle, never place hand in jet of a nozzle. The jet will enter deeply and destroy the tissue. Fuel entering the blood may cause blood poisoning.

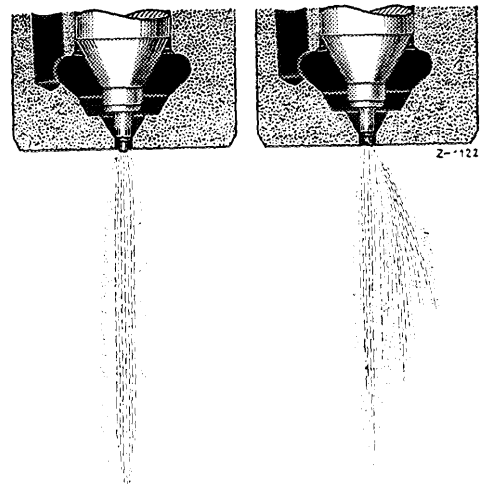
A. Throttle pintle and flat surface pintle nozzle

1 **Energetically pump 5 times through injection nozzle on tester. Then test buzzing of nozzle, slowly actuating hand lever for this purpose (approx. 1 stroke per second).**



107-20857

2 Test jet: During short, fast partial strokes (at least 2 strokes per second) the jet should be rather closed and tear off well.



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

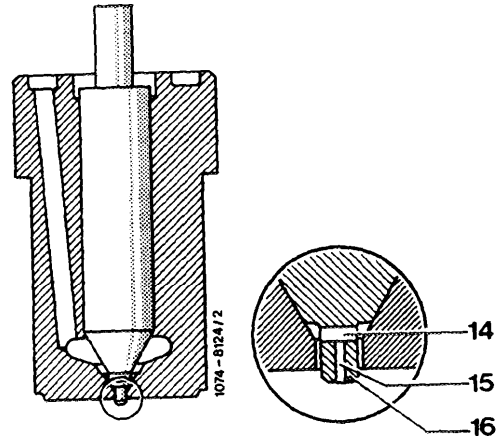
3 Check opening pressure: Nominal value 115-125 bar with new nozzle, min. 100 bar with used nozzles.

Move hand lever slowly downward (at least 1 stroke per second) and read opening pressure on pressure gauge.

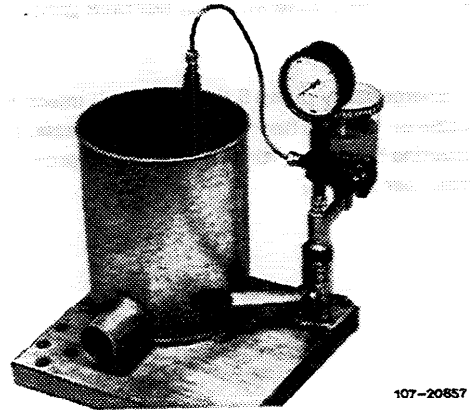
For this test, shutoff valve mut be open.

B. Hole-type pintle nozzle

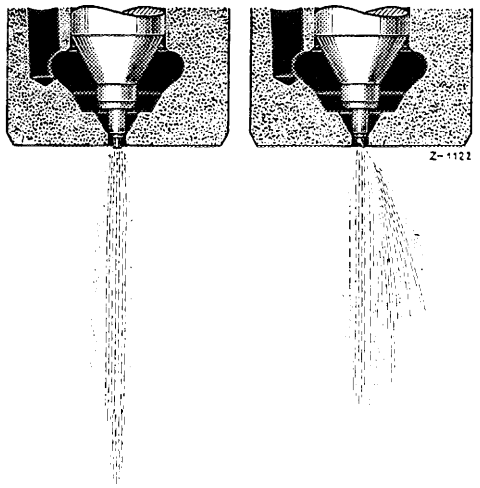
1 Prior to testing: Check longitudinal bore (15) with cleaning needle of 0.18 mm dia. for passage.



2 Energetically pump 5 times through injection nozzle on tester. Then test buzzing of nozzle, slowly actuating hand lever for this purpose (approx. 1 stroke per second).



3 Test jet: During short, fast partial strokes (at least 2 strokes per second) the jet should be rather closed and tear off well.

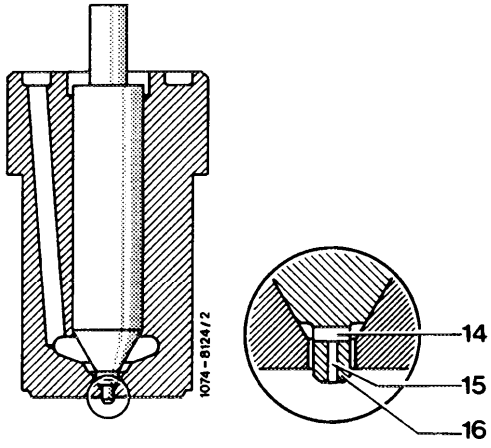


A Jet pattern closed and well atomized
B Jet pattern torn up, too wide and spreading

4 Generate initial jet by moving hand lever slowly in downward direction (4-6 s/stroke).

A vertical cord-like jet should come out of center bore (15).

Note: On new nozzles it is rather difficult to generate the initial jet, for this reason check longitudinal bore with cleaning needle of 0.18 mm dia. for passage.



5 Check opening pressure.

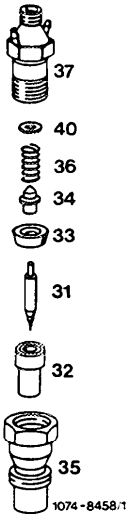
Nominal value: 115-1 25 bar with new nozzle, at least 100 bar with used nozzle.

Move hand lever slowly in downward direction (approx. 1 stroke per second) and read opening pressure on pressure gauge.

Shutoff valve must be open during test.

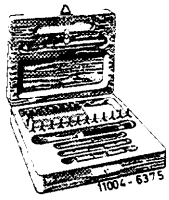
07.1–137 Disassembling, cleaning, assembling and adjusting injection nozzles (following checkup)

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



31	Nozzleneedle..	Visual and slide test; on hole-type pintle nozzle clean center and longitudinal bore
32	Nozzle body	Remove combustion residue
33	Nozzle holder element	Touch up on surface plate
34	Thrustpin	Tip should point toward upper part
35	Nozzle holder lower part	70-80 Nm
36	Compression spring	
37	Nozzle holder upper part.	Clamp in protective jaws
40	Steel disk	Adjust for opening pressure. Nominal value 115-125 bar with new nozzle or nozzle to be newly adjusted, min. 100 bar with used nozzle. Opening pressure will be higher or lower depending on thickness of disk, 0.05 mm provide approx. 3 bar difference in pressure

Special tools

Torque wrench with plug-in ratchet, 1/2'' square, 25-130 Nm		001 589 66 21 00
Socket wrench element 27 mm, 1/2'' square		001 589 65 09 00
Cleaning unit		000 589 00 68 00

Conventional tool

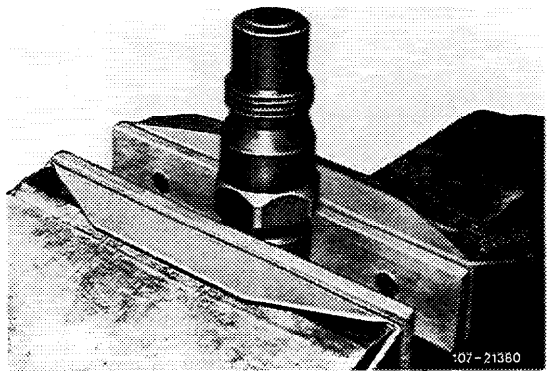
Cleaning needles 0.18 mm dia.	e.g. Bosch, D-7000 Stuttgart order no. KDEP 2900/4

Note

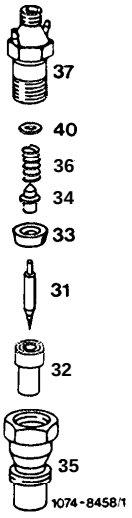
During disassembly, make sure that the nozzle body, the nozzle needle and the individual parts are not mixed up among each other.

Disassembly

1 Clamp injection nozzle holder upper part (37) with protective jaws into vice in such a manner that the leak oil line connections are not damaged.



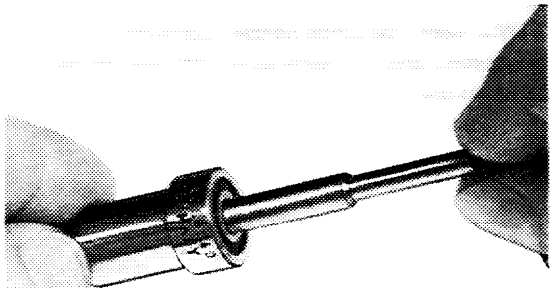
2 Disassemble injection nozzle.



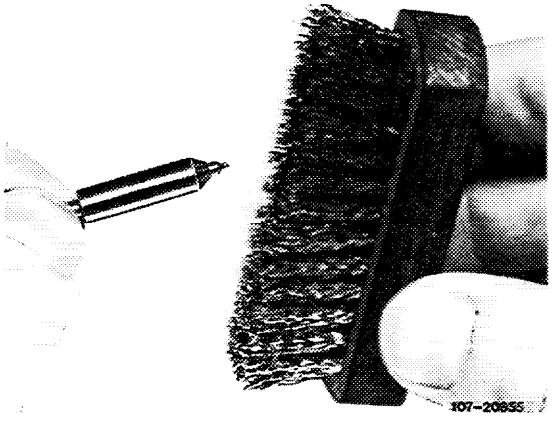
31 Nozzle needle
32 Nozzle body
33 Nozzle holder element
34 Pressure pin
35 Injection nozzle holder lower part
36 Compression spring
37 injection nozzle holder upper part
40 Steel disk for making adjustments

Cleaning and testing

3 Remove combustion residue on nozzle needle seat with cleaning cutter.



4 Clean nozzle needle and nozzle body with brass brush.

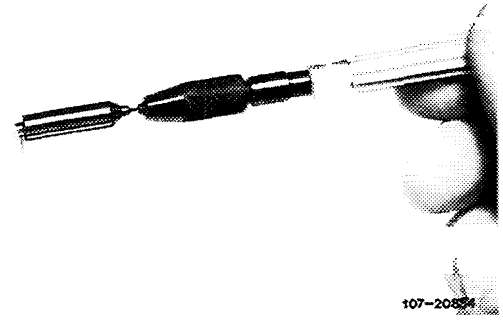


5 Visual and slide check.

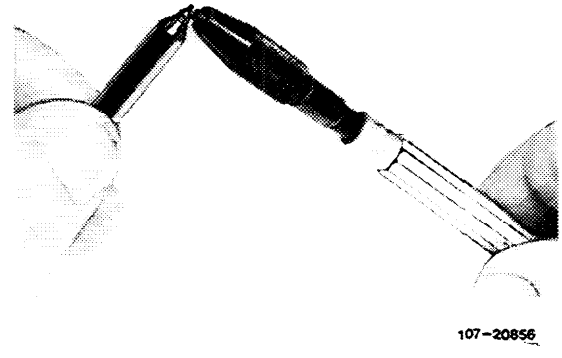
Immerse nozzle into filtered diesel fuel. With nozzle body held vertically, the nozzle needle should slide under its own weight in direction of nozzle seat.

6 Touch up nozzle holder element (33) on surface plate.

7 With hole-type pintle nozzle, additionally clean longitudinal and transverse bore with cleaning needle 0.18 mm dia.



Longitudinal bore

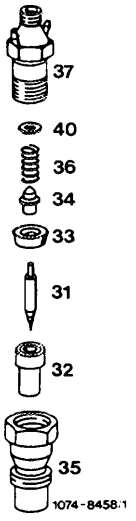


Transverse bore

Assembly

8 Assemble injection nozzle. Tightening torque for injection nozzle holder 70-80 Nm.

9 Check injection nozzle for function (07.1-135) and adjust, if required (07.1—137).



31 Nozzle needle
32 Nozzle body
33 Nozzle holder element
34 Pressure pin
35 Injection nozzle holder lower part
36 Compression spring
37 Injection nozzle holder upper part
40 Steel disk for making adjustment

Adjusting

10 Add **thicker** or thinner disks depending on opening pressure.

Thicker disk = increases opening pressure
Thinner disk = reduces opening pressure

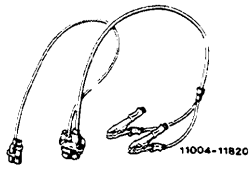
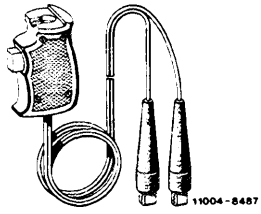
Disks are available from 1 .O to 1.8 mm thick, in steps of 0.05 to 0.05 mm. An increase of preload by 0.05 mm increases opening pressure by approx. 3.0 bar.

07.1-145 Checking fuel pump

Job no. of work units or standard texts and flat rates data 07-5700.

Test value	
Delivery at min. 200 rpm (stop lever pushed)	min. 200 ml/30 s

Special tools

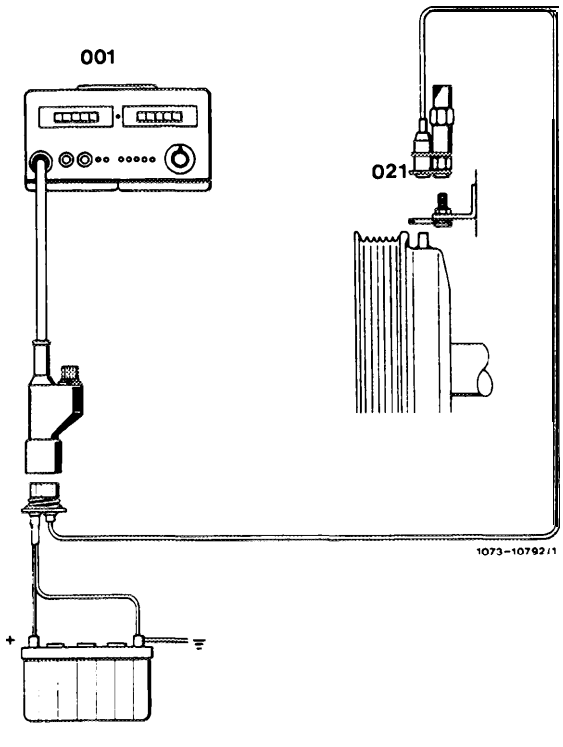
TDC-impulse transmitter	 11004-11820	601 589 04 21 00
Contact handle (for starting)	 11004-8487	001 58946 21 08

Conventional tools

Digital tester	e.g. Bosch, MOT 001.03
Measuring glass or measuring cup (min. 1 liter)	
Stop watch	

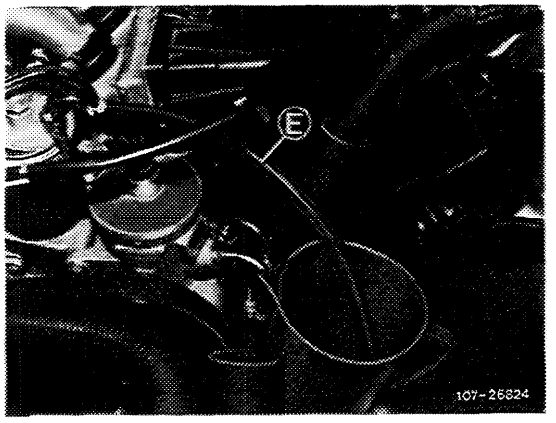
Testing

1 **Connect digital tester (001) according to connection diagram.**



001 Digital tester
021 TDC-impulse transmitter

2 Disconnect return flow line (E) and hold into measuring cup.



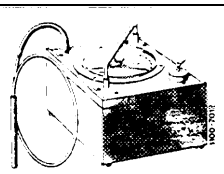
3 Move ignition lock into position ,,0'', injection pump will then be at ,,zero" delivery.

4 Start motor for 30 seconds with separate starting cable, with battery intact (10.0 V when starting) a delivery quantity of min. 200 ml must be attained. Renew delivery pump, if required.

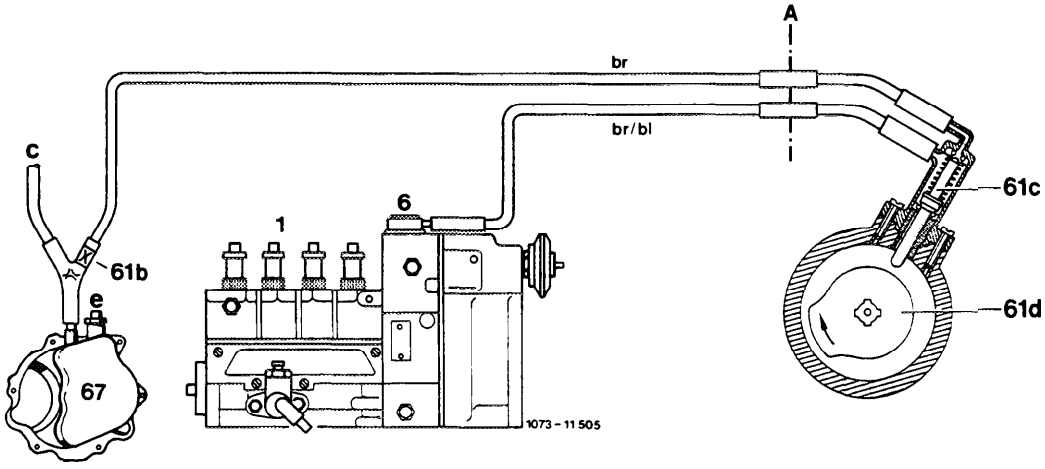
07.1-150 Checking vacuum shutoff for leaks

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

Special tool

Vacuum tester		116 589 25 21 00

Function diagram



1 Injection pump
6 Vacuum control unit (stop)
61b Orif ice 0.5 mm dia.
61c Valve ignition starter switch
61d Cam disk ignition starter switch
67 Vacuum pump

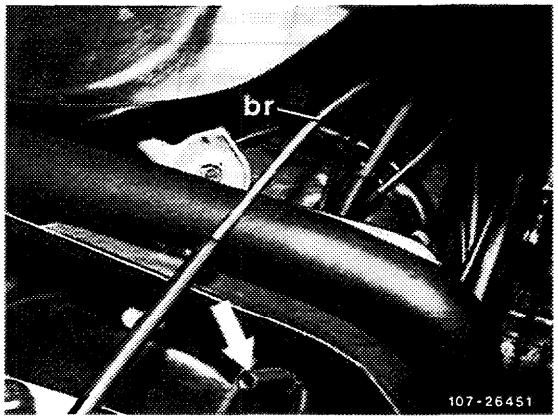
A Intermediate wall
c Remaining consumers
e To brake unit

bl = blue
br = brown

Testing

1 Set ignition key on steering lock to position ,,2''.

2 Pull suction line (brown) out of connection (arrow).

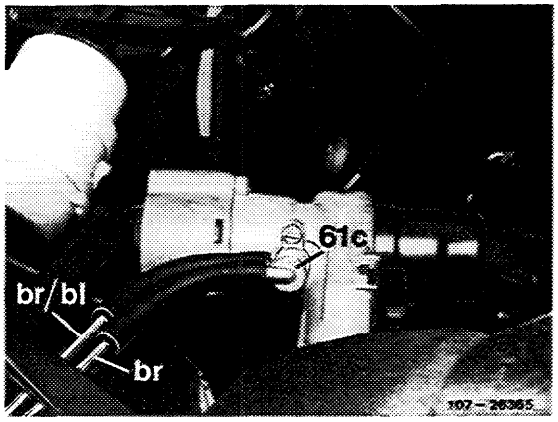


3 Connect tester and activate with vacuum.

If readout on pressure gauge is not changing, the valve for key starting system is tightly sealed.

If pressure gauge shows a vacuum drop, valve (61c) on steering lock is leaking.

Attention!
Prior to exchanging valve for key-starting system and the vacuum control unit of injection pump, check hose lines and their connections.

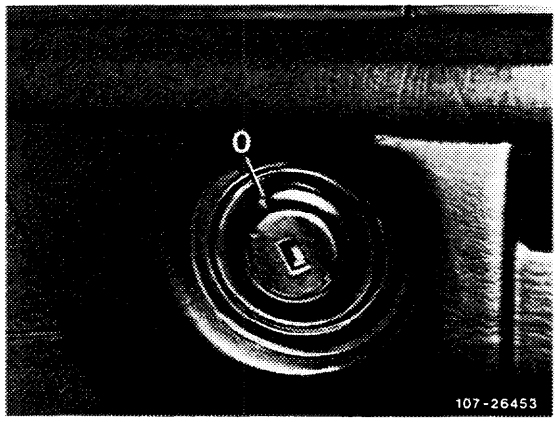


4 Renew valve for key-starting system on steering lock.

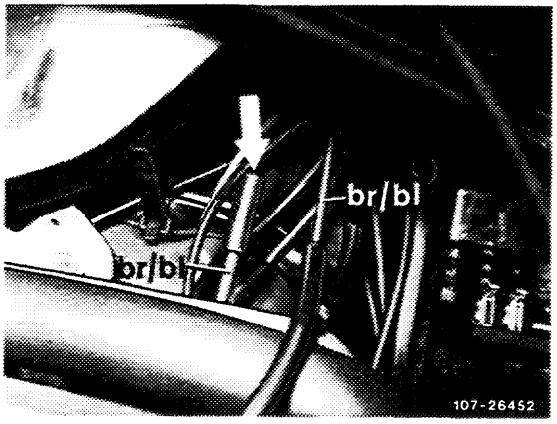
5 Turn ignition key on steering lock back to position ,,O".

If pressure gauge shows a vacuum drop, the vacuum control unit or the valve may be leaking.

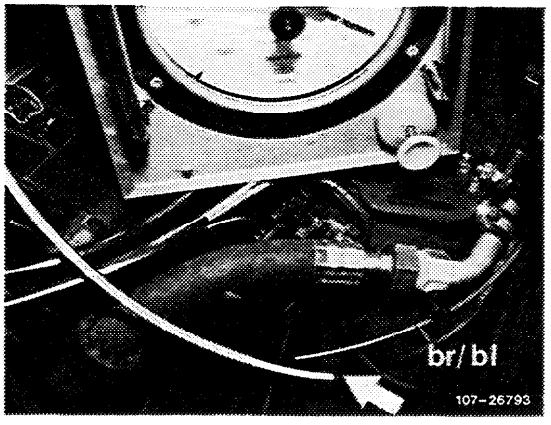
6 In such a case, disconnect tester on suction line.



7 Pull control line (brown/blue) from connection (arrow).



Layout standard version and (USA)



@California version

8 Connect tester to connection and activate with vacuum.

If pressure gauge shows a vacuum drop, the vacuum control unit of injection pump is leaking.

Attention!
Prior to exchanging vacuum control unit, check hose lines and their connections.

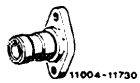
9 Renew vacuum control unit (07.1–220).

07.1-200 Removal and installation of injection pump

Job no. of work units or standard texts and flat rates data 07–8410.

Test value	
injection timing (indirect), position of engine	15° after TDC cylinder 1

Tightening torques (reference values)	Nm
Closing plug on regulator (measuring point)	30-35
Injection line	1 O-20
Injection pump flange	20-25
Central fastening bolt on injection timer (lefthand threads)	40-50

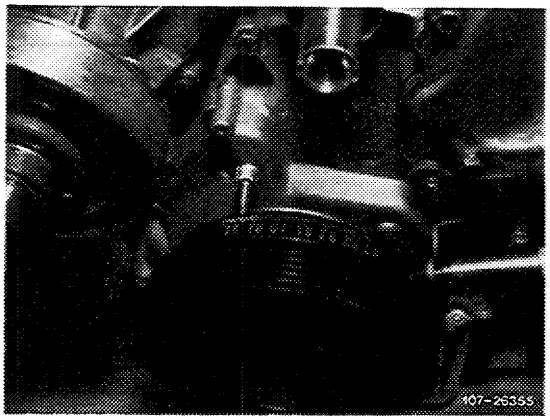
Special tools		
Torque wrench with plug-in ratchet, 1/2''square, 25-l 30 Nm		001 589 66 21 00
Locking screw		601 589 05 21 00
Socket wrench element 27 mm, 1/2'' square		001 589 65 09 00
Box wrench element open, 14 mm, 1/2'' square for injection lines		000 589 77 03 00
Serration wrench for rotating injection pump		601 589 00 08 00

Removal and installation

1 Remove radiator shell and fan (20–335).

2 Completely remove air cleaner (09–400).

3 Rotate crankshaft in direction of rotation to 15° after TDC of 1st cylinder.



4 Disengage belt tensioner (13-340).

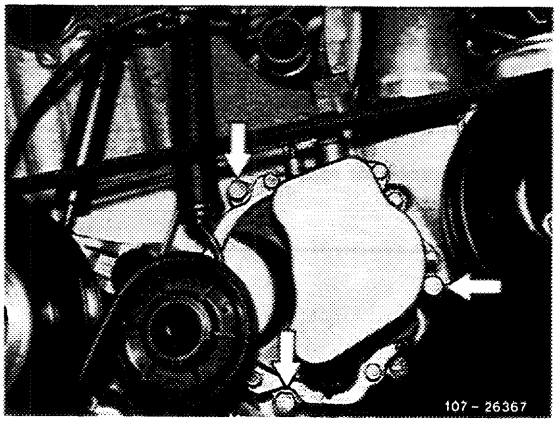
5 Remove chain tensioner (05-310).

6 Connect injection and fuel lines to injection pump.

7 Pull vacuum lines from vacuum control unit for idle speed increase, stop unit and vacuum control valve, if required.

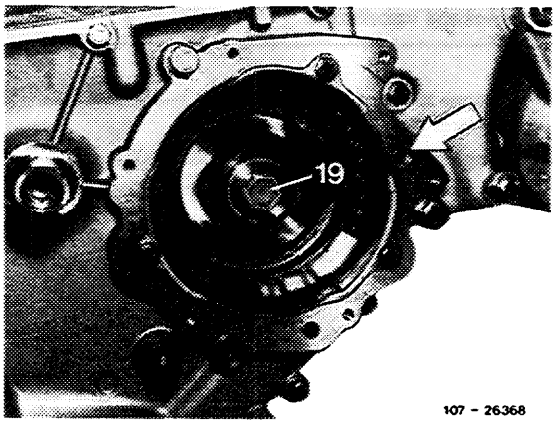
8 Disengage regulating linkage on adjusting lever.

9 Remove vacuum pump (43-610).

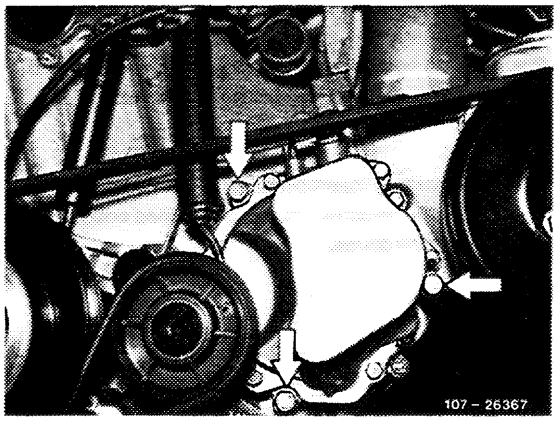


10 Loosen central fastening screw (19) (lefthand thread), apply counterhold to crankshaft for this purpose.

Attention!
LEFTHAND THREADS



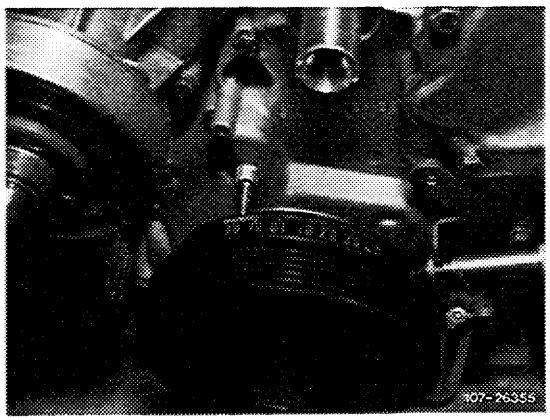
11 Unscrew fastening screws (arrows) and screw on supporting holder.



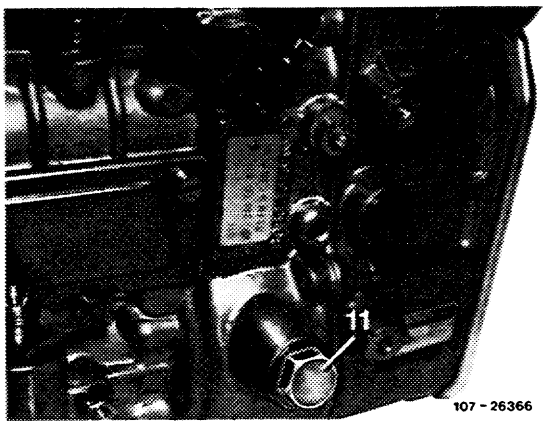
12 Pull out injection pump toward the rear.

Installation notes

13 Check whether engine is at 15° after TDC of first cylinder.

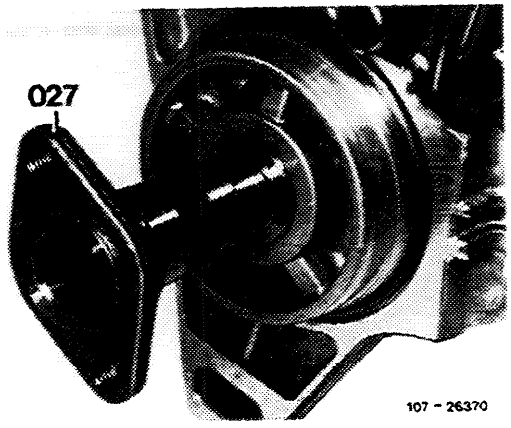


14 Remove closing plug (11).



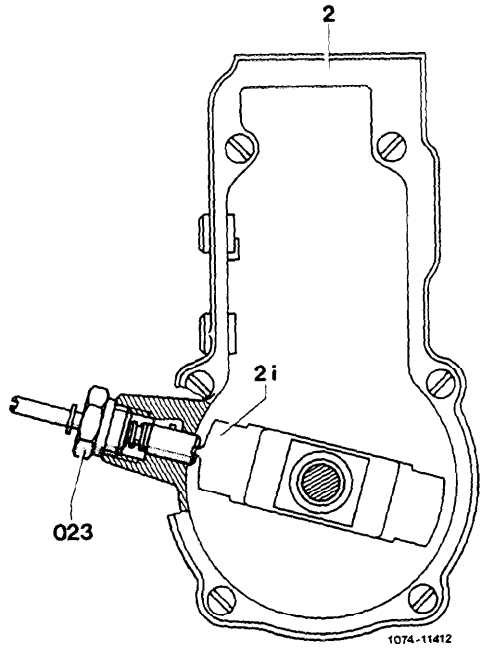
15 Rotate injection pump with serration wrench (027) on injection pump camshaft until lug of regulator shows up on bore, slip in locking gauge (023) in this position until gauge is noticeably engaging.

Attention!
Risk of damaging injection pump!
As soon as the injection pump is installed and tightened, remove locking gauge.



16 Assemble engine.

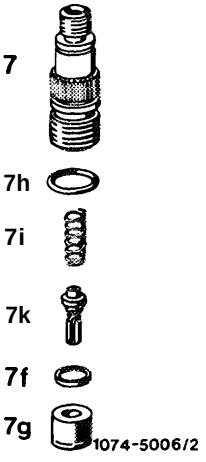
Note: When the engine is started, the injection system will automatically vent itself.



07.1-210 Renewing delivery valve seal

Job no. of work units or standard texts and flat rates data 07-8627

Removal and installation of air cleaner (09–400).



7 **Delivery valve holder** ..... **35 Nm**
7f **Copper seal** ..... **Renew**
7g **Delivery valve carrier** ..... **Note installation position**
7h **O-ring.** ..... **Lubricate prior to installation.**
7i **Compression spring**
7k **Delivery valve**

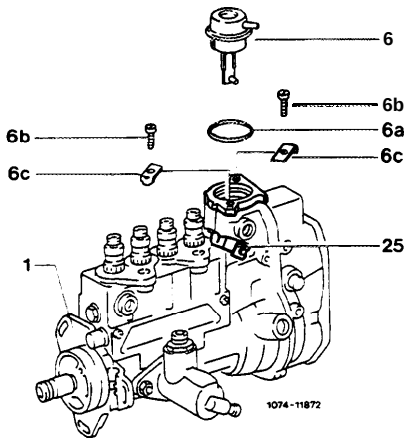
Special tool

Socket wrench element notched tooth 17 x 20, 1/2" square	 11004-8544	**617 589 01 09 00**

07.1-220 Renewing vacuum control unit

Job no. of work units or standard texts and flat rates data 07-8618

Removal and installation of air cleaner (09-400).



1 Injection pump

6 Vacuum control unit (stop). ..... Slightly lift during removal, tilt rearward toward engine end and pull out

6a O-ring

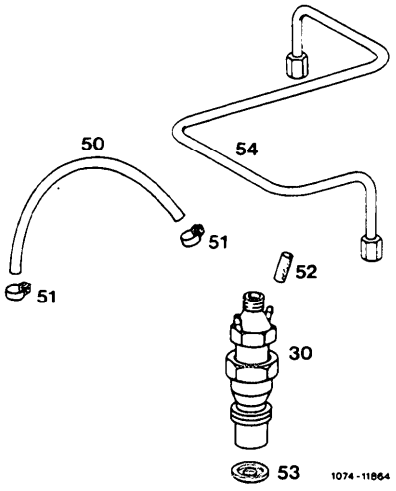
6b Screw

6c Holder

25 Emergency stop lever. ..... During installation, push and let connecting rod of vacuum control unit engage in rocker of emergency stop lever

07.1-230 Removal and installation of injection nozzle

Job no. of work units or standard texts and flat rates data 07-6810.

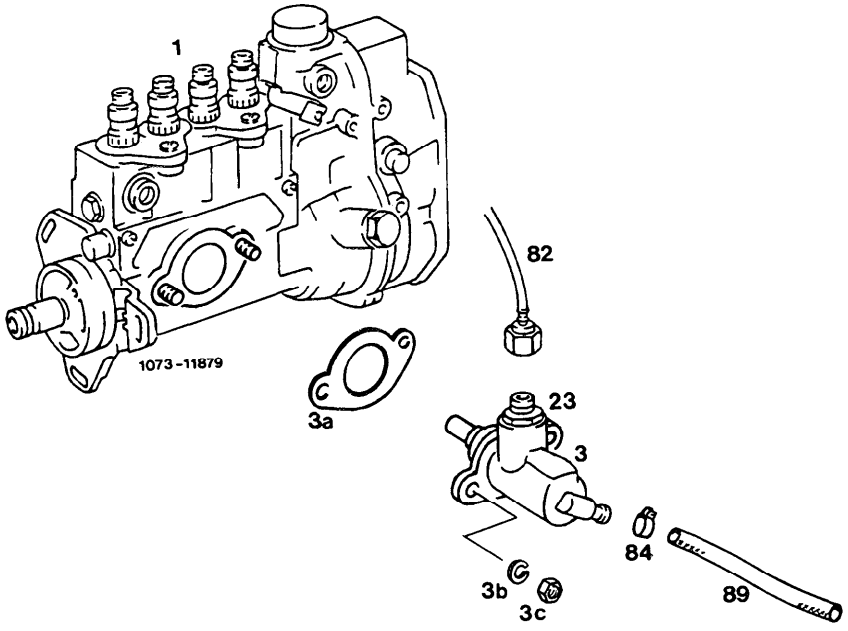


30 Injection nozzle ..... 70-80 Nm, use special tool 001 589 65 09 00
50 Leak oil hose
51 Hose clamp (S only)
52 Closing plug
53 Nozzle reed. ..... Renew
54 Injection lines cylinder 1 .....10–20 Nm (reference value)

07.1-235 Removal and installation of fuel pump

Job no. of work units or standard texts and flat rates data 07-5710.

Remove air cleaner cover (09–400).



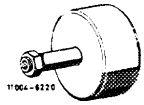
1 Injection pump
3 Fuel pump. . . . . During removal, catch emerging engine oil
3a Gasket
3b **Circlip,** 2 each
3c Nut, 2 each
23 Pressure connection
82 Fuel filter inlet
84 Clamp
89 Suction line

07.1-240 Removal and installation of injection timer

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

Tightening torque	Nm
Central fastening screw on injection timer (lefthand threads)	40-50

Special tools

Socket wrench element 27 mm, 1/2'' square		001 589 65 09 00
Torque wrench with plug-in ratchet, 1/2'' square, 25-l 30 Nm		001 589 66 21 00
Impact puller		116589203300
Threaded bolt M 6		11658901 3400

Note

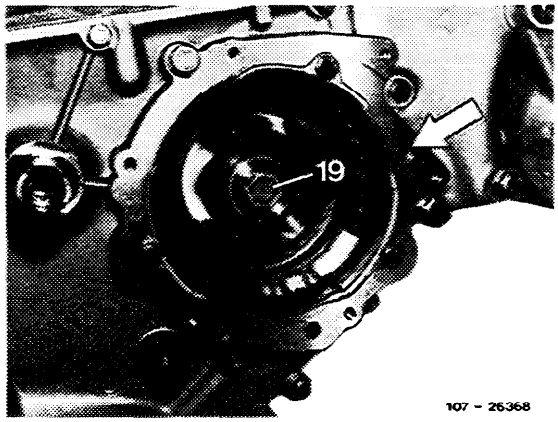
Injection pump removed, remove and install injection pump (07.1-200).

Removal and installation

1 Remove assembly basket.

2 Remove camshaft timing gear for slackening chain.

3 Pull out locking pin (arrow).



4 Push timing chain in outward direction, slip in sheet metal strip of approx. 0.2 mm for this purpose, and pull out injection timer.

5 Install injection pump.

6 Check injection timing with digital tester (07.1-I 12). adjust, if required (07.1-I 17).

07.1-245 Renewing fuel filter

Job no. of work units or **standard texts and flat rates data 07-5513.**

Note

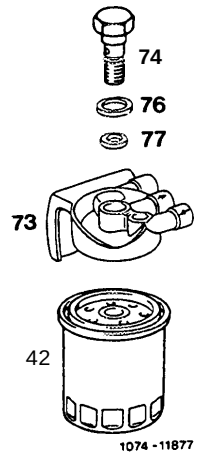
Fuel system will vent itself automatically when starting, owing to higher delivery capacity of fuel pump and throttles (orifices) in filter top, as well as on injection pump.

Function diagram, refer to 07.1-010 section ,,G".

Removal and installation

1 Disengage vacuum line on holder.

2 Loosen fastening screw (74) and remove filter (42) in downward direction.



42 Filter
73 Fuel filter top
74 Screw
76 O-ring
77 Sealing ring (aluminum)