



**Introductory
Service
Information**

**water-cooled
VANAGON**

MAINTENANCE AND ADJUSTMENTS

Introduction

This booklet is part of a two booklet set of Introductory Service Information for the 1983 Water-cooled Vanagon.

Book 1—Introductory Service Information WSP-521-112-00. This book contains information on technical changes and theory of operation for each product change. This book contains information on the engine, fuel injection, as well as other changes.

Book 2—Vanagon Maintenance and Adjustments WSP-521-113-00. The maintenance and adjustments book contains repair information for Repair Groups 10 through 34 as well as the complete wiring diagram.

All of the information contained in these booklets is based on the latest product information at the time of printing. Please consult the Product Circular booklets and Microfiche information for the latest repair information.

Service Policy for Vanagon 4 speed Transmission

The new 4 speed manual transmission in the water-cooled Vanagon is not repairable at this time. Repairs are limited to outside checks and adjustments such as the shift linkage.

If a problem develops which requires repair of the transmission other than outside adjustments, the transmission should be replaced. Exchange units are available through the parts department.

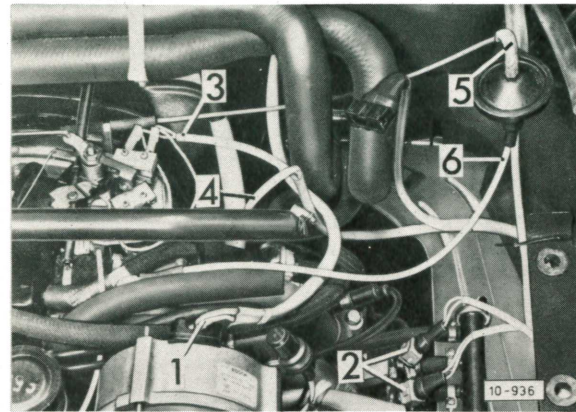
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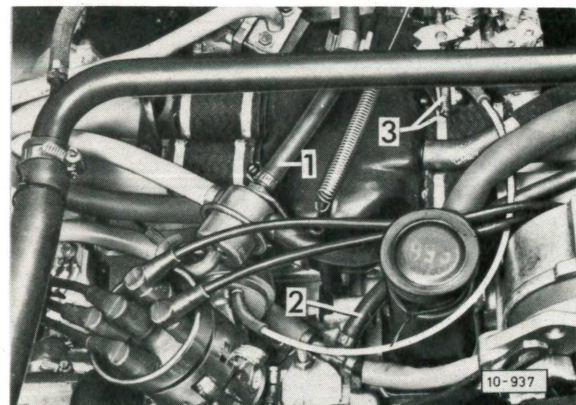
Engine, removing

Work sequence

- disconnect ground cable from battery
- remove air cleaner with air flow sensor and air intake duct



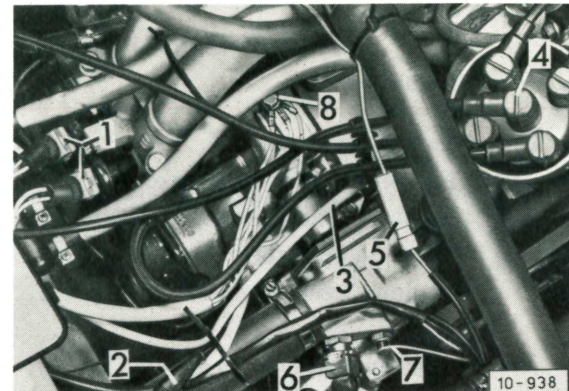
- disconnect wire 1 at alternator
- disconnect following:
 - plugs 2 at injectors
 - plug 3 at throttle valve switch
 - plug 4 at auxiliary air regulator
- disconnect hoses 5 and 6 at charcoal filter valve



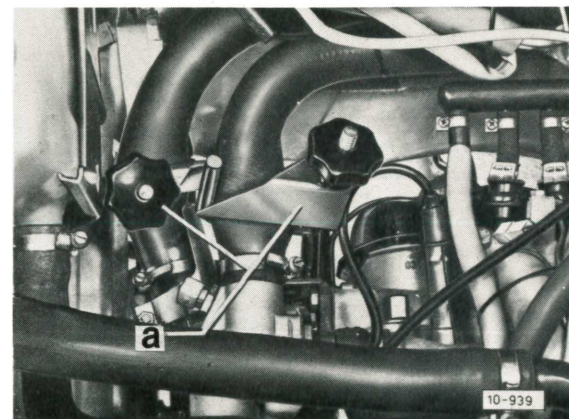
- disconnect and plug fuel hoses 1 and 2
- remove accelerator cable from throttle valve lever

Automatic Transmission

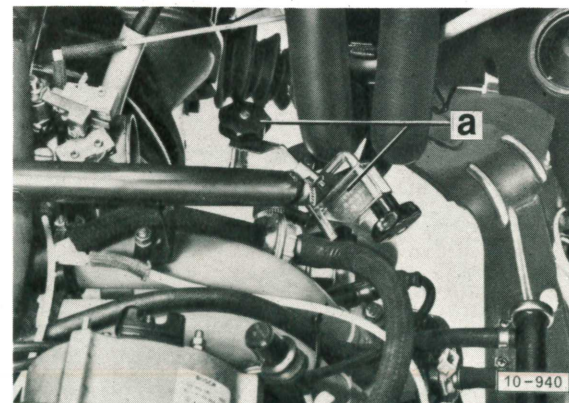
- remove circlip and spring 3 from accelerator rod



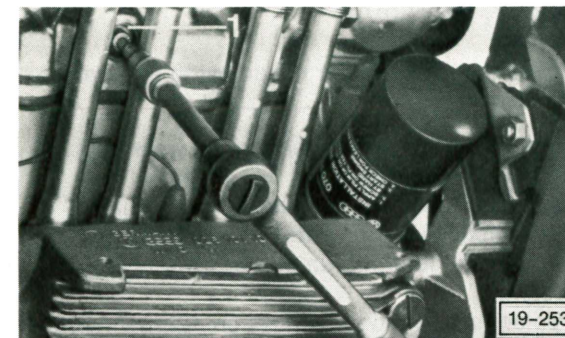
- disconnect following:
 - plugs 1 at injectors
 - plug 2 at oxygen sensor
 - plug 3 and 4 at ignition distributor
 - plug 5 at oil pressure switch
 - plug 6 at temperature sensor
 - plug 7 at temperature sender
 - plug at coolant level warning switch (not shown—located in coolant expansion tank)
- remove ground connectors 8



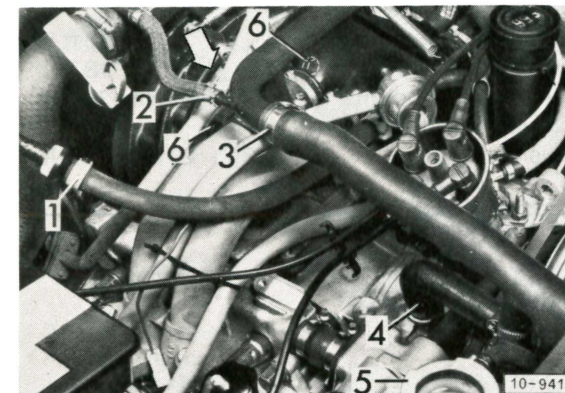
- block coolant hoses with clamps a
 - a = universal clamp—local supply



- block coolant hoses with clamps a
 - a = universal clamp—local supply
- open coolant expansion tank cap



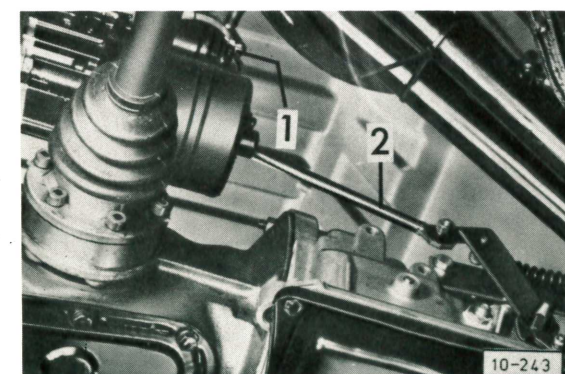
- remove drain plugs 1 at cylinder heads and drain coolant



- disconnect brake booster line 1
- disconnect coolant hoses 2, 3 and 4
- remove coolant expansion tank 5
- remove engine/transmission bolt/nut 6 on left and right sides

Automatic Transmission

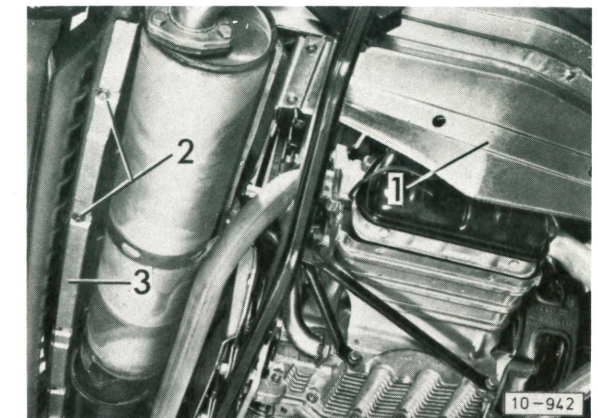
- remove three bolts which attach torque converter to drive plate through hole on top of trans. housing (arrow)



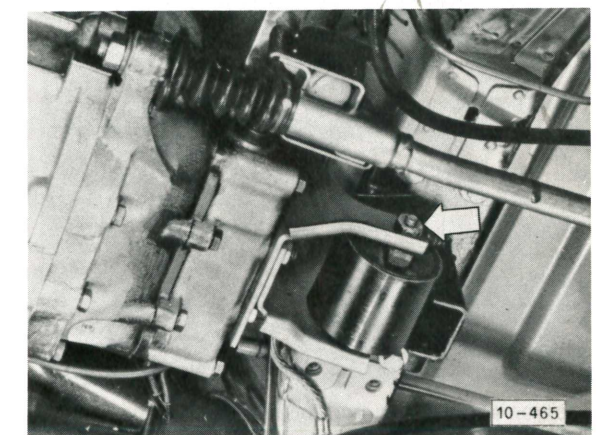
- disconnect wiring 1 at starter

Automatic Transmission

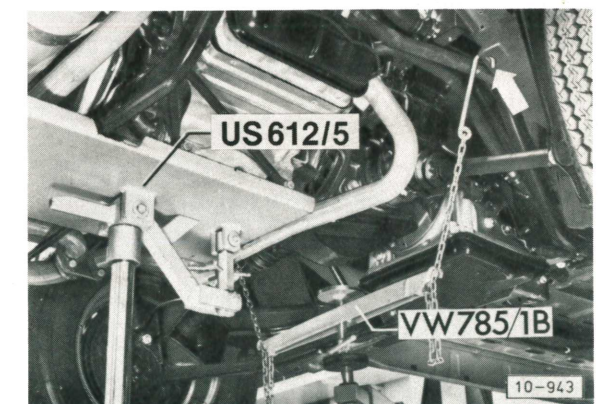
- remove accelerator rod 2



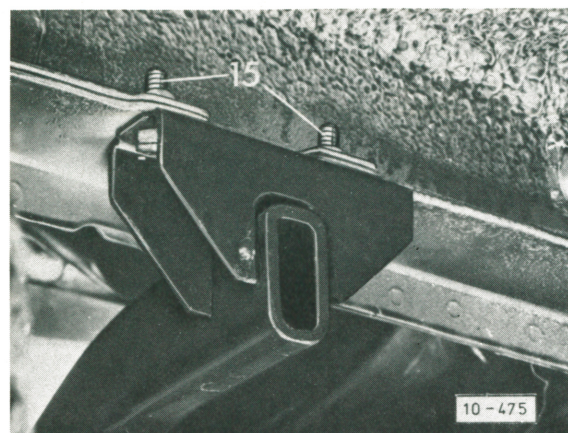
- remove plates 1 on left and right sides
- remove bolts 2, do not remove plate 3



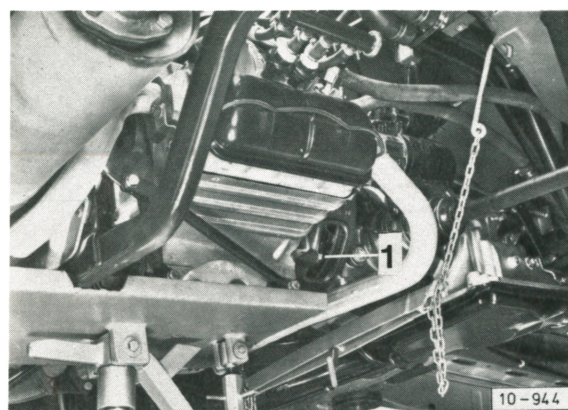
- loosen transmission mount bolt (arrow)



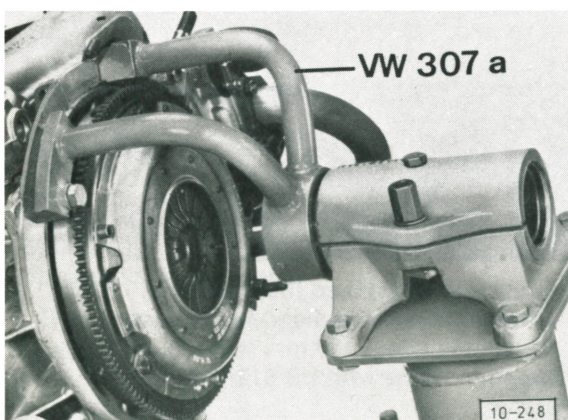
- attach VW 785/1B so that distance between support pad and transmission housing is about 120 mm (4 3/4 in.)
- support engine with US 612/5 and floor crane



— remove engine carrier bolts 15



- lower engine/transmission assembly until transmission rests on VW 785/1B
- when lowering, adjust angle of inclination on floor crane head and keep wiring harness aside so that it can pass oil filler tube
- remove nuts 2 of lower engine mounting bolts
- remove engine from transmission and lower it out of vehicle



— mount engine on repair stand with engine holder VW 307a

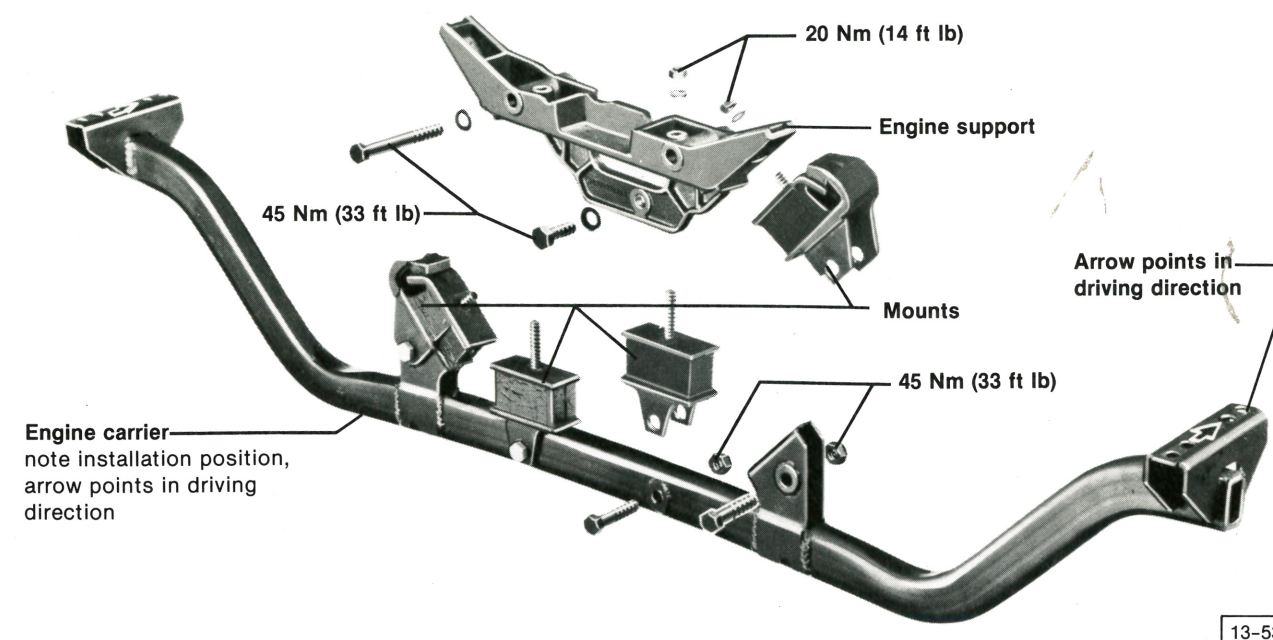
Engine, installing

Proceed in reverse order of removing and note following:

- check clutch release bearing for wear and replace if necessary
- lubricate clutch release bearing and main shaft splines lightly with MoS₂ grease (do not lubricate guide sleeve for release bearing)
- replace all self-locking nuts on engine mounts
- check and adjust, if necessary, accelerator cable/throttle controls, see Repair Group 20

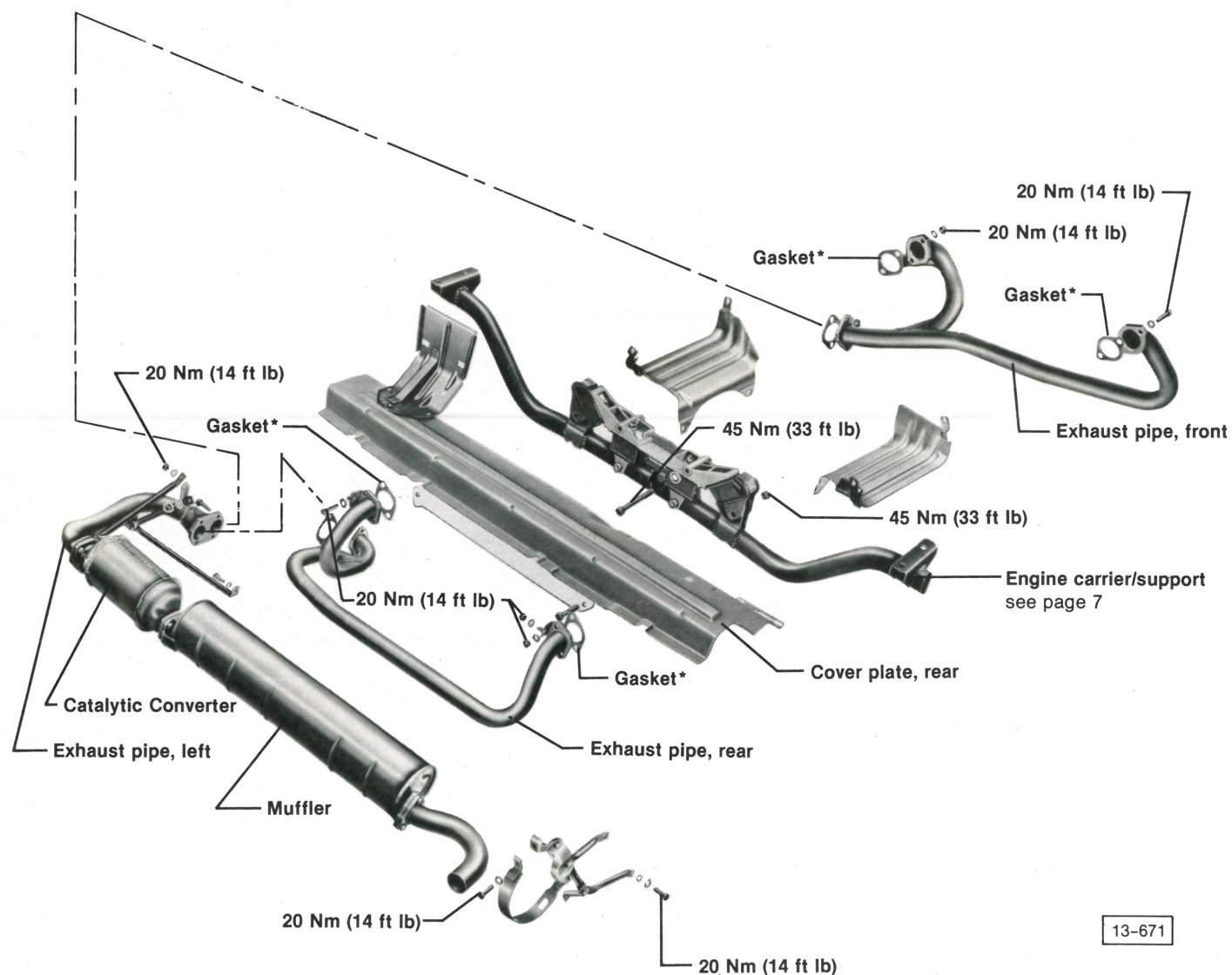
Tightening torques:

- | | |
|-----------------------------------|------------------|
| • engine to transmission | 30 Nm (22 ft lb) |
| • engine carrier to body | 25 NM (18 ft lb) |
| • transmission mounts | 30 Nm (22 ft lb) |
| • torque converter to drive plate | 20 Nm (14 ft lb) |



Note

Arrows on carrier must point to front of vehicle when reinstalling.
Remove carrier as complete assembly

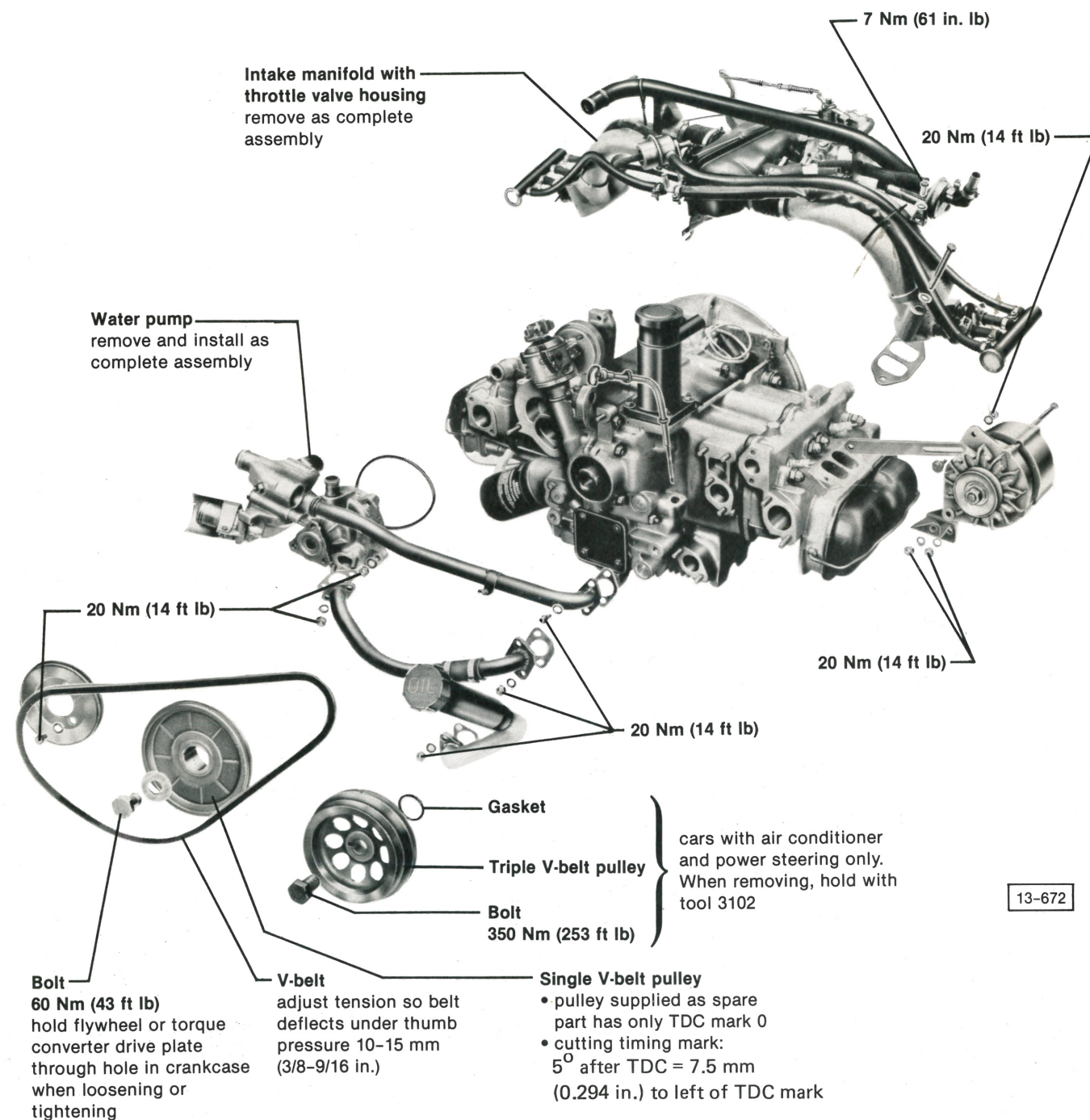


*metal surface faces cyl. head

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Note

Tighten all hoses with hose clamps

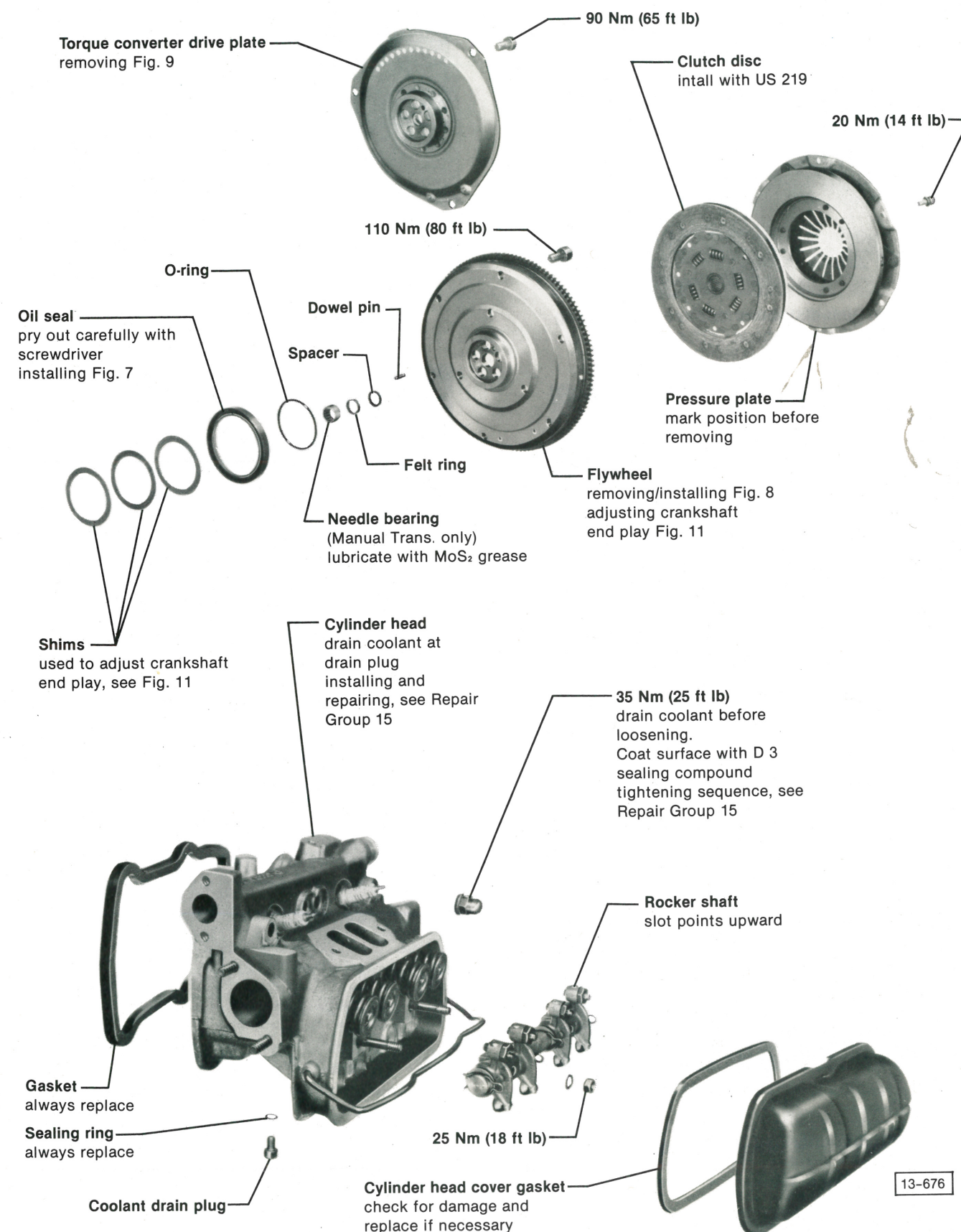
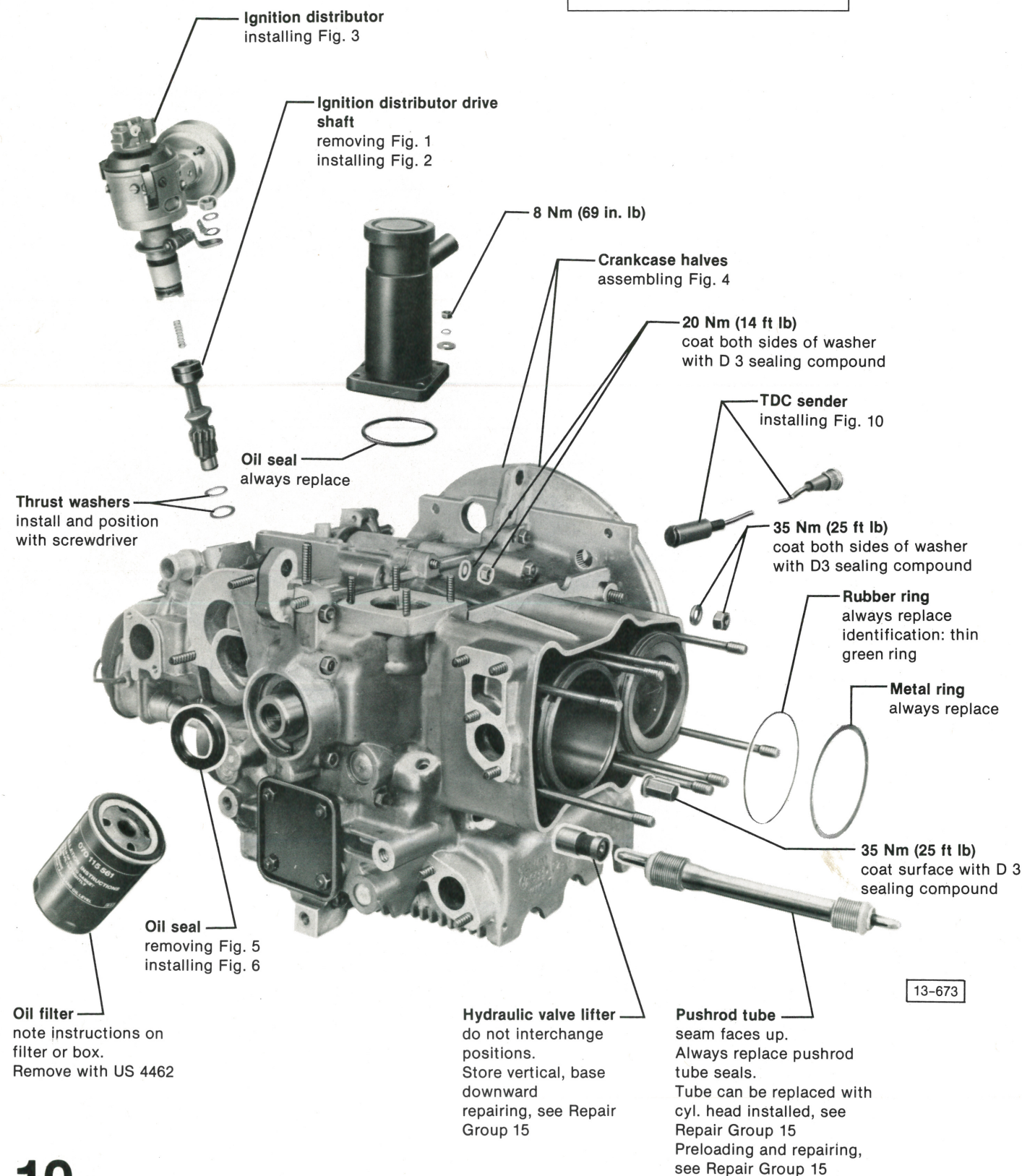


cars with air conditioner and power steering only. When removing, hold with tool 3102

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CAUTION

When assembling crankcase halves, see Fig. 4



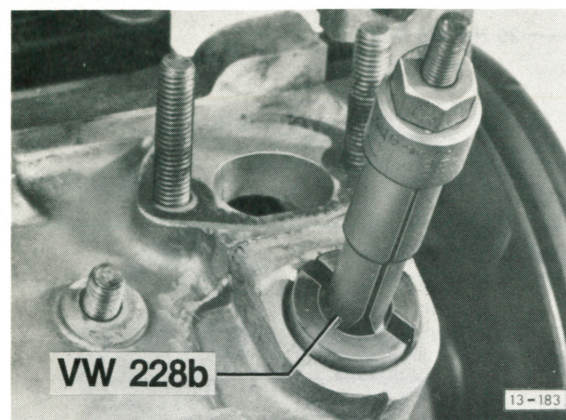


Fig. 1 Ignition distributor drive shaft, removing
— use puller as shown

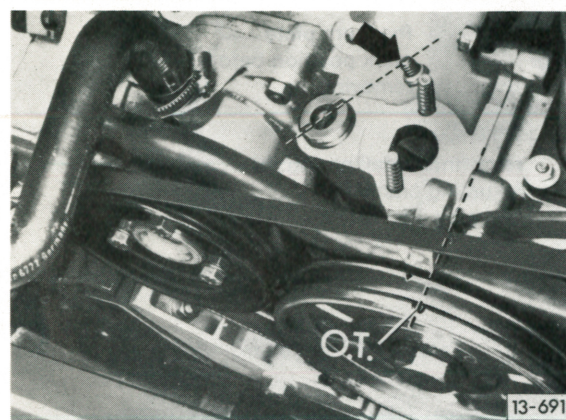


Fig. 2 Ignition distributor drive shaft, installing
— set crankshaft to TDC on cyl. No. 1
— install drive shaft so that offset slot faces bolt (arrow)
— small segment faces water pump

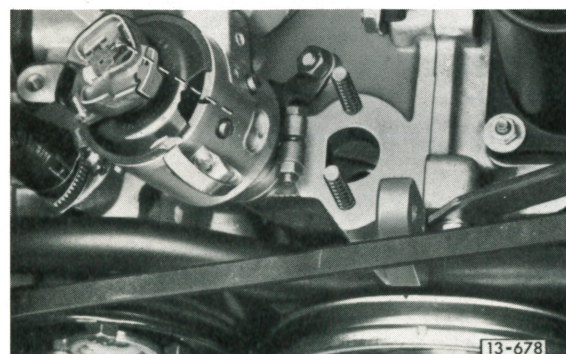


Fig. 3 Ignition distributor, installing
— set cylinder No. 1 to TDC
— turn rotor until mark on rotor is in line with mark on distributor housing (cyl. No. 1)

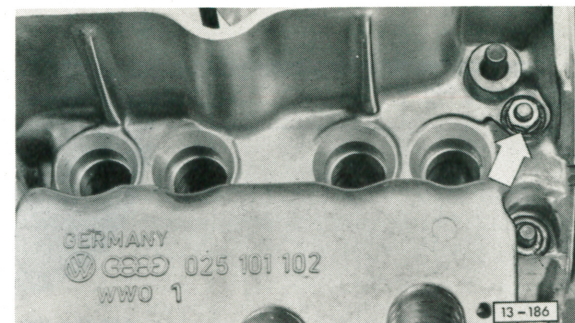


Fig. 4 Crankcase halves, assembling
— first tighten M 8 nut (arrow)
— then tighten all M 10 nuts
— tighten remaining M 8 nuts

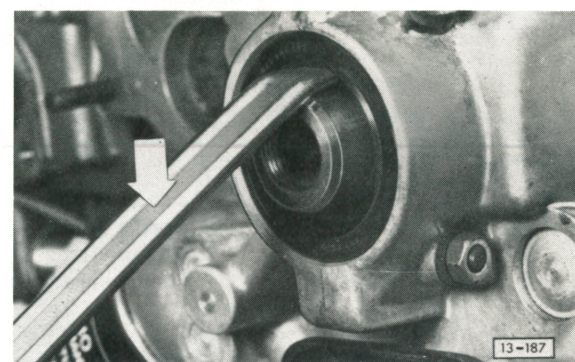


Fig. 5 Crankshaft oil seal, removing
— pry out

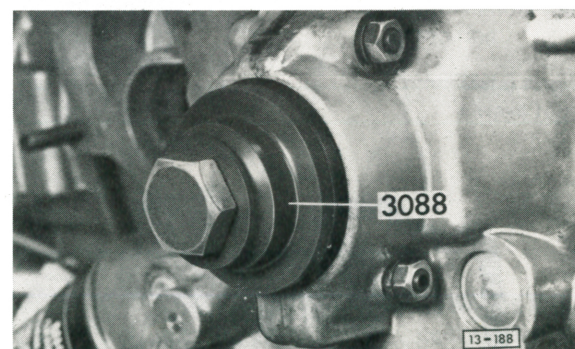


Fig. 6 Crankshaft oil seal, installing
Single pulley
— coat seal lips with oil and install seal with 3088 and pulley bolt (without washer)
— then tighten bolt **with washer** until stop
Triple pulley
— coat seal lips with oil and install with 3088 and pulley bolt **without washer** and tighten bolt until stop

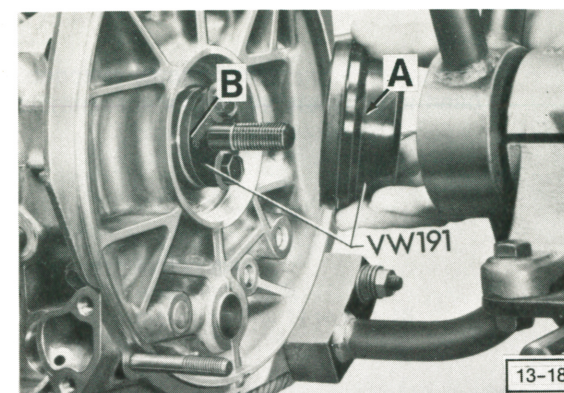


Fig. 7 Crankshaft oil seal (flywheel side), installing
— coat seal lips with oil and put on guide A
— screw base B into crankshaft and press in guide A with seal until seated

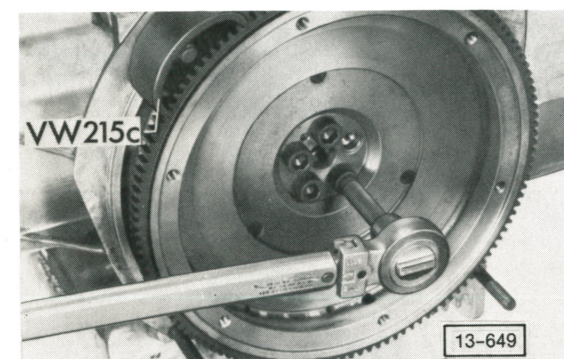


Fig. 8 Flywheel, removing
— lock flywheel with tool

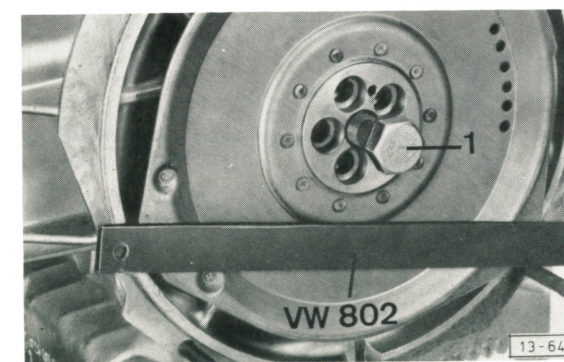


Fig. 9 Torque converter drive plate, removing
— lock plate with VW 802
— to remove, screw in bolt 1 (M 18 x 1.5 x 60). Thread length of bolt must be at least 45 mm (1.77 in.)

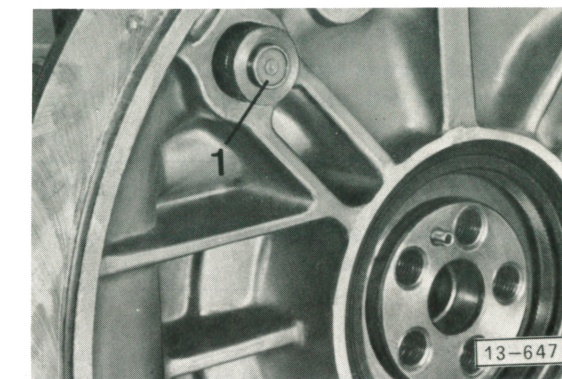


Fig. 10 TDC sender, installing
— use piston pin and plastic hammer to drive TDC sender in until stop
— do not damage inner ring 1

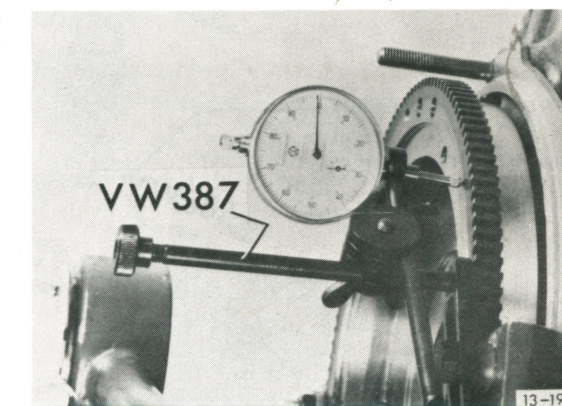


Fig. 11 Crankshaft end play, checking/adjusting
— check crankshaft end play
• new: 0.07–0.13 mm (0.003–0.005 in.)
• wear limit: 0.15 mm (0.006 in.)
— if out of specification proceed as follows:
— install flywheel with 2 shims but **without** O-ring and crankshaft oil seal
— mount dial indicator with bracket on crankcase
— move crankshaft in and out and measure movement (crankshaft end play)
— determine thickness of 3rd shim

Example

dial indicator reading	0.44 mm (0.017 in.)
specified end play	— 0.10 mm (0.004 in.)
thickness of 3rd shim	0.34 mm (0.013 in.)

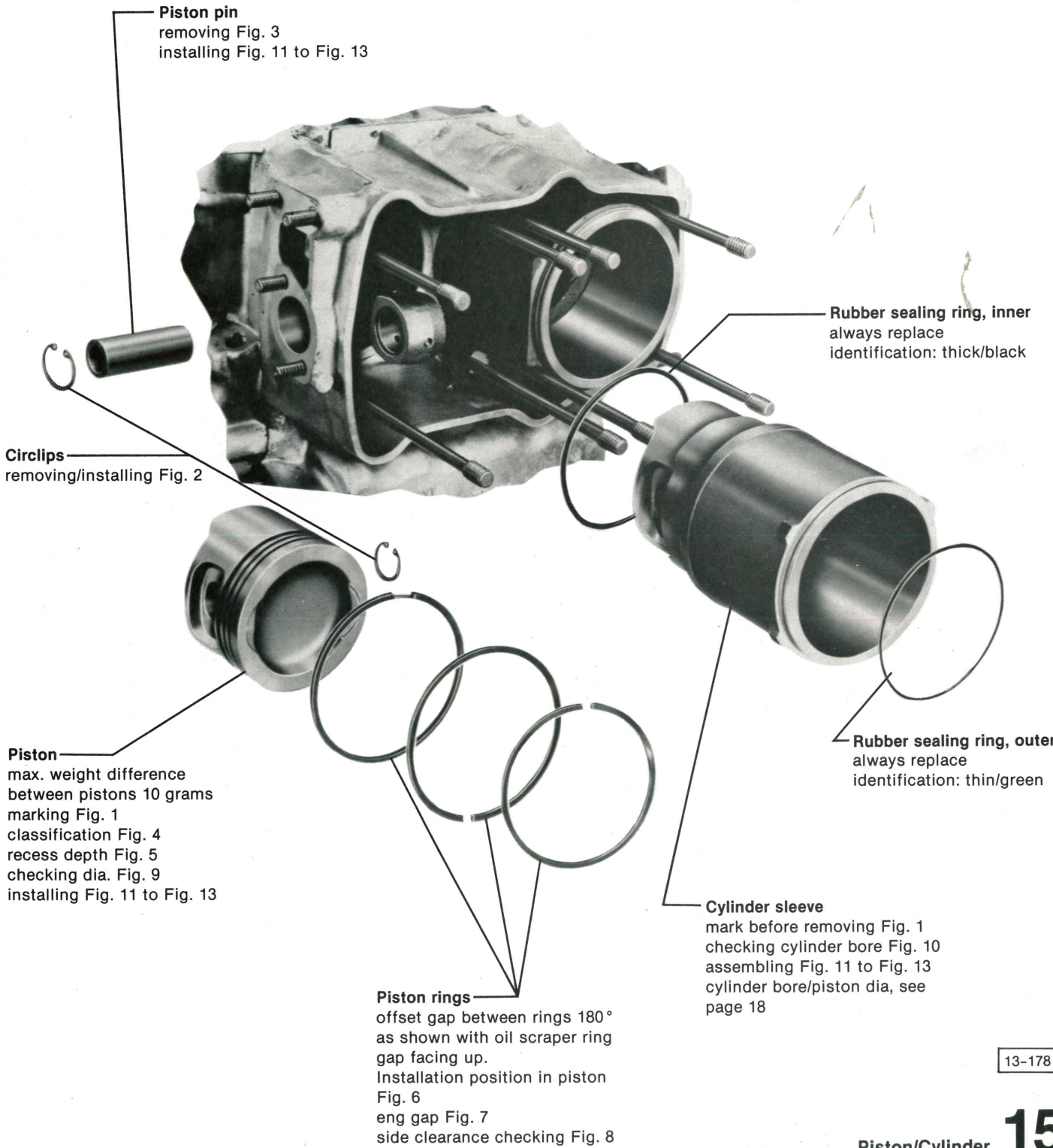
— go to next page

Note
Thickness of shim is etched on shim.
Always recheck with micrometer

CAUTION
Always install **three** shims to obtain correct crankshaftend play

- remove flywheel
- install O-ring, crankshaft oil seal and felt ring
- install all three shims
- install flywheel
- tighten bolts to 110 Nm (80 ft lb)
- recheck crankshaft end play

Note
Remove deposits (scale) from cylinders/crankcase and cylinders/cylinder head



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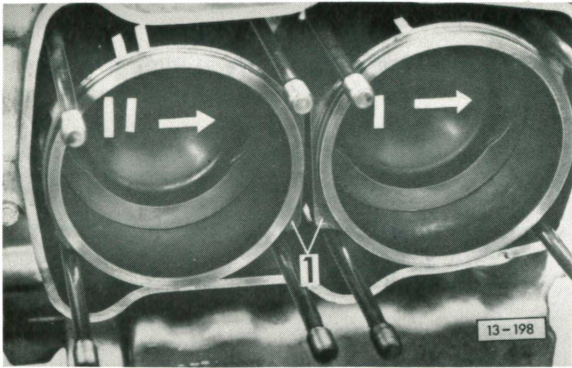


Fig. 1 Piston/cylinder sleeve, marking

- arrow points to flywheel
- before removing, mark matching numbers on pistons and cylinder sleeves
- cylinder boss 1 faces inward

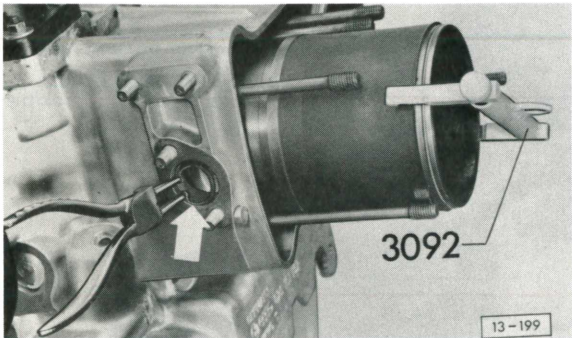


Fig. 2 Circlips, removing/installing on V-belt side:

- with piston at TDC, pull out cylinder sleeve with 3092 until piston pin circlip visible

at flywheel end:

- with first cylinder sleeve removed

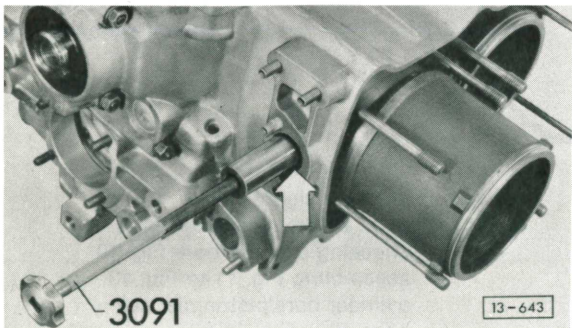


Fig. 3 Piston pins, removing

- remove pins as shown

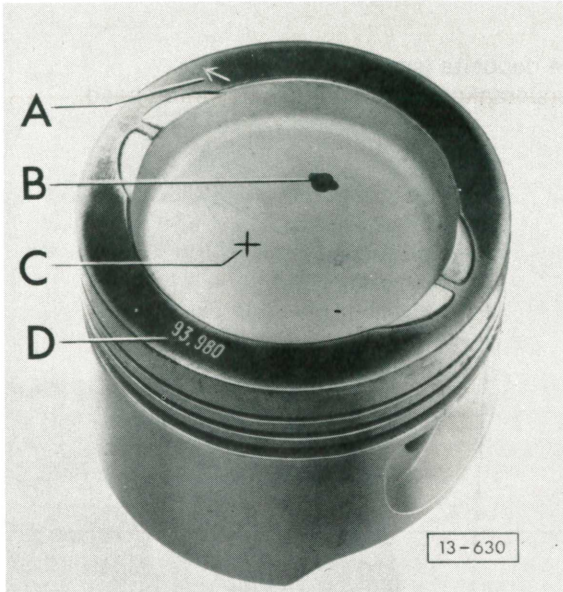


Fig. 4 Piston classifications

- A = arrow (stamped on) must point toward flywheel when piston is installed
- B = paint dot (blue) indicates matching size
- C = weight group (+ or -) stamped on
 - weight = 448-456 grams
 - + weight = 457-464 grams
- D = piston size in millimeters (see table on page 18)

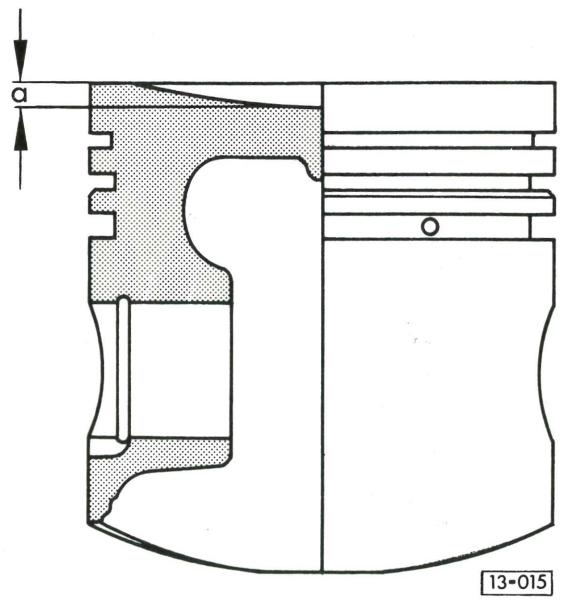


Fig. 5 Piston recess depth

- measurement a = 11.65 mm (0.458 in.)

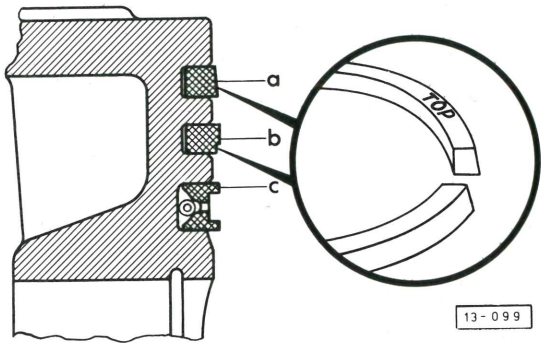


Fig. 6 Piston rings, installation position

- TOP mark on piston rings must face to top of piston
- a = upper ring
- b = lower ring
- c = oil scraper ring

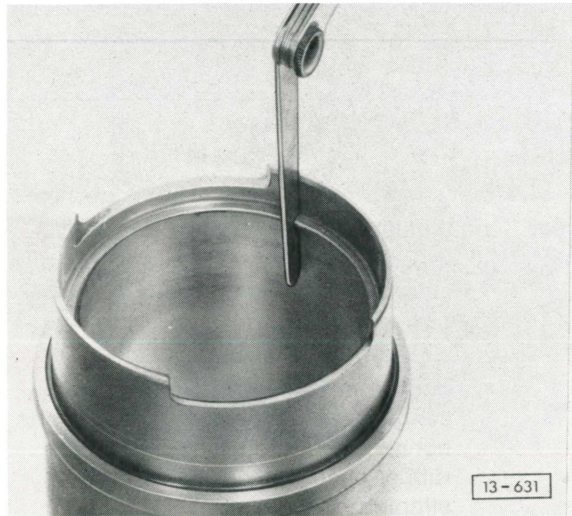


Fig. 7 Piston ring end gap, checking

- push ring in squarely from lower cylinder opening about 4-5 mm (3/16 in.)
- measure gap with feeler gauge

ring end gap	wear limit
upper ring = 0.30-0.45 mm (0.012-0.018 in.)	0.90 mm (0.035 in.)
lower ring = 0.30-0.50 mm (0.012-0.020 in.)	0.90 mm (0.035 in.)
oil scraper = 0.25-0.40 mm (0.010-0.016 in.)	0.95 mm (0.037 in.)

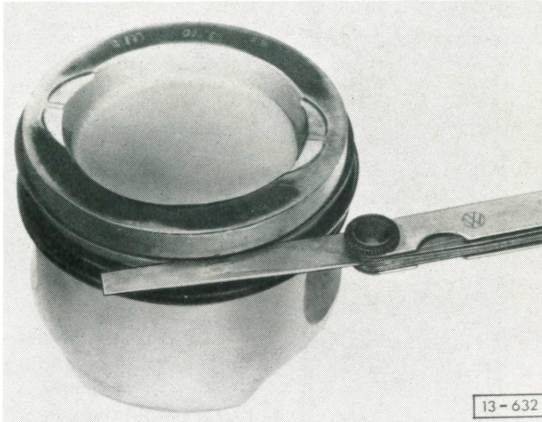


Fig. 8 Piston ring side clearance, checking

clearance	wear limit
upper ring = 0.05-0.08 mm (0.002-0.003 in.)	0.12 mm (0.005 in.)
lower ring = 0.04-0.07 mm (0.002-0.003 in.)	0.10 mm (0.004 in.)
oil scraper = 0.02-0.05 mm (0.001-0.002 in.)	0.10 mm (0.004 in.)

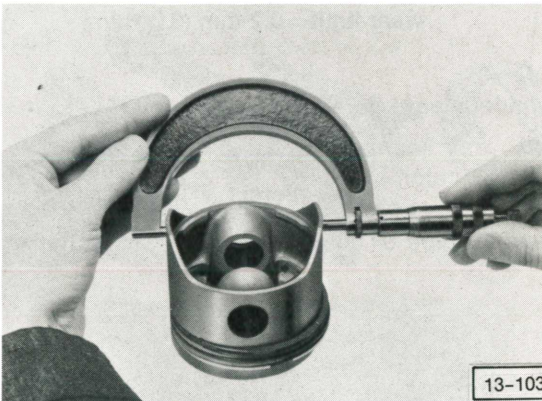


Fig. 9 Piston, checking diameter/wear

- measure at bottom of skirt approx. 15 mm (9/16 in.) from edge (diameter stamped in top of piston)

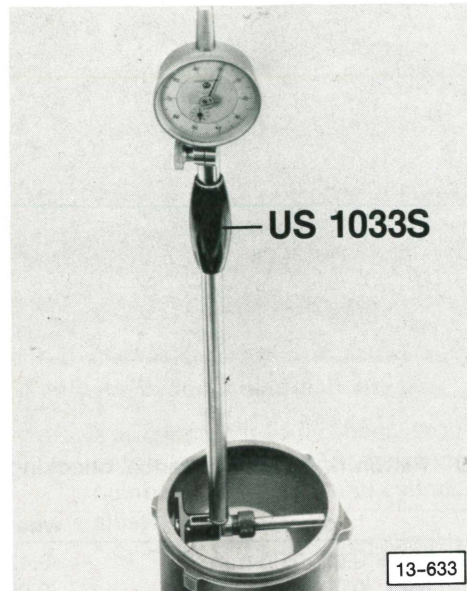


Fig. 10 Cylinder sleeve, checking for wear

- measure 10–16 mm (3/8–5/8 in.) from top
 - piston to sleeve clearance is sleeve diameter minus piston diameter
 - new = 0.03–0.06 mm (0.001–0.002 in.)
 - wear limit = 0.2 mm (0.008 in.)

Cylinder sleeve bore/Piston diameter

size	color	cylinder diameter	matching piston diameter
standard	blue	94.005–94.016 mm	93.98 mm

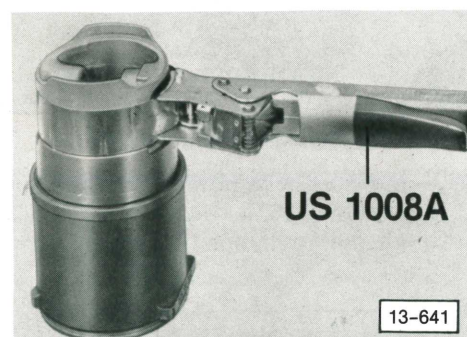


Fig. 11 Piston and cylinder sleeve, installing

Note

Remove deposits (scale) around cylinders/ crankcase and cylinders/cylinder head

- replace rubber sealing rings for cylinder sleeves:
 - cylinder head end = thin ring (green)
 - crankcase end = thick ring (black)
- install piston into cylinder sleeve (flywheel side first)
 - arrow on piston points toward flywheel
 - gap of oil scraper ring must be to top
 - piston ring gaps offset by 180° (see page 15)
- insert circlip for piston pin on flywheel side of piston

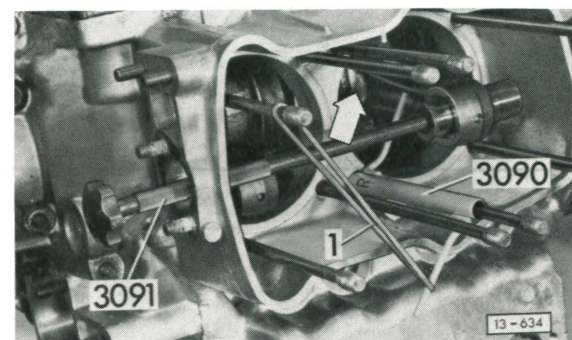


Fig. 12 Piston and cylinder sleeve, installing

- note markings on connecting rod support 3090
 - R = right side of engine
 - L = left side of engine
- push connecting rod support onto center stud so finger of tool supports connecting rod; then secure it with rubber band 1 to prevent it from slipping
- align connecting rod such that piston pin can be installed through hole in housing
 - crankshaft must be at TDC
 - lug on rod faces up

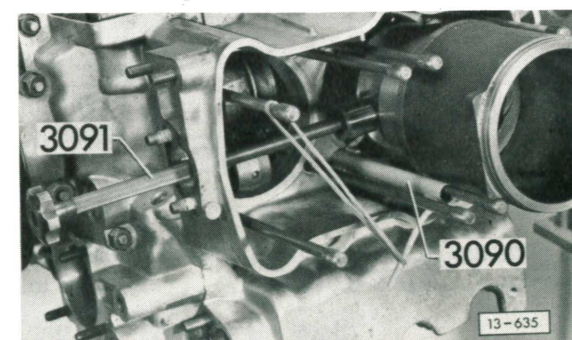


Fig. 13 Piston and cylinder sleeve, installing

- install piston pin with 3091 and insert circlip

CAUTION

When assembling crankcase halves, observe tightening sequence and tightening torque (see page 12, Fig. 4)

Oil pickup line with filter screen
cleaning Fig. 4
replacing Fig. 5

Crankcase
clean and blow through all oil channels with compressed air.
Coat joining surfaces with D3 sealing compound

Main bearing No. 2
lubricate before installing crankshaft.
Note installation position when removing and install in same position as removed

Camshaft end cap
coat with sealing compound when installing.
Watch installation position

Main bearing No. 1
lubricate before installing crankshaft.
Hole for dowel offset toward flywheel

Dowel
check for tight fit in case

Camshaft bearing
lubricate before installing.
Tabs must engage in recess

Crankshaft
disassembling/assembling,
see page 21

Camshaft
runout, checking Fig. 1
end play, checking Fig. 2
installing Fig. 3

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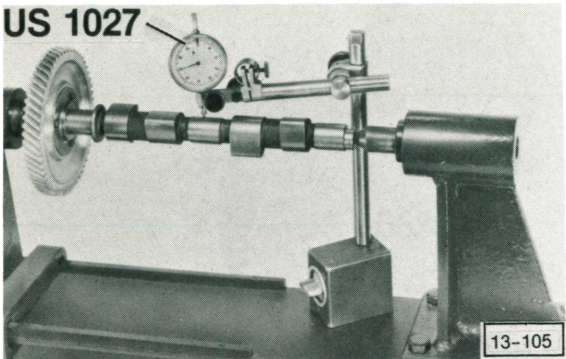


Fig. 1 Camshaft runout, checking

- wear limit 0.04 mm (0.0015 in.)

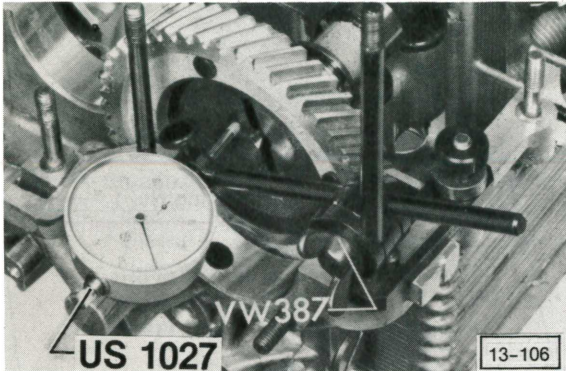


Fig. 2 Camshaft end play, checking

- wear limit 0.16 mm (0.006 in.)
- if out of specification, replace camshaft bearings

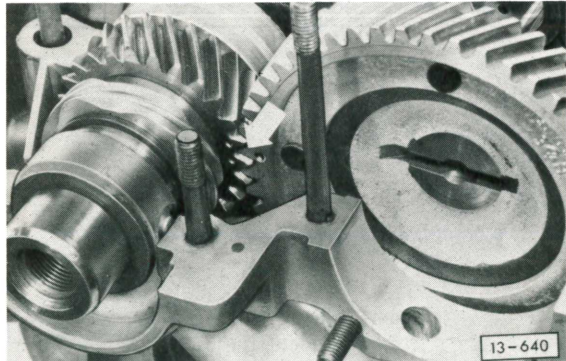


Fig. 3 Camshaft, installing

- mark on camshaft gear tooth must be between marks on crankshaft gear teeth (arrow)
- check backlash of timing gears
 - 0.0–0.05 mm (0–0.002 in.)
 - backlash must be hardly noticeable

- turn crankshaft **backward**
- camshaft must not lift out of bearings
- if camshaft lifts out of bearings, install camshaft with smaller timing gear

Note

To obtain specified backlash, camshafts with various size timing gears are available. Markings are on **inner** face of timing gear

Example

“–0.1”, “+0.1”, “+0.2”, indicates in 1/100 mm how much pitch radius differs from standard pitch radius “0”

CAUTION

Mark **0** on **outer** face of camshaft timing gear is timing mark and must not be confused with markings on **inner** face. Crankshaft timing gear is available in one size only

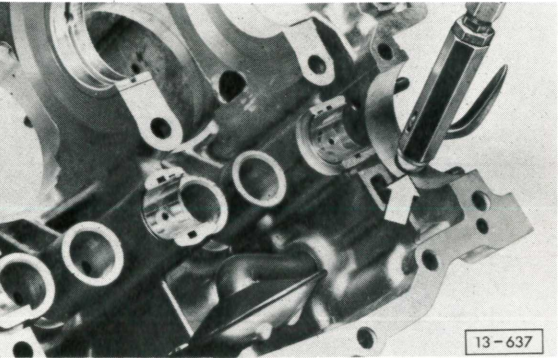


Fig. 4 Oil pickup line with filter screen, cleaning

- clean oil channels by blowing through with compressed air (arrow)

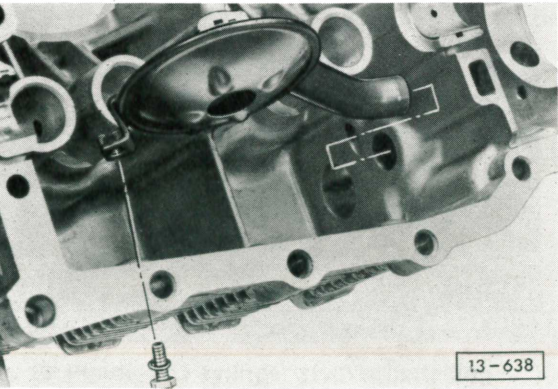
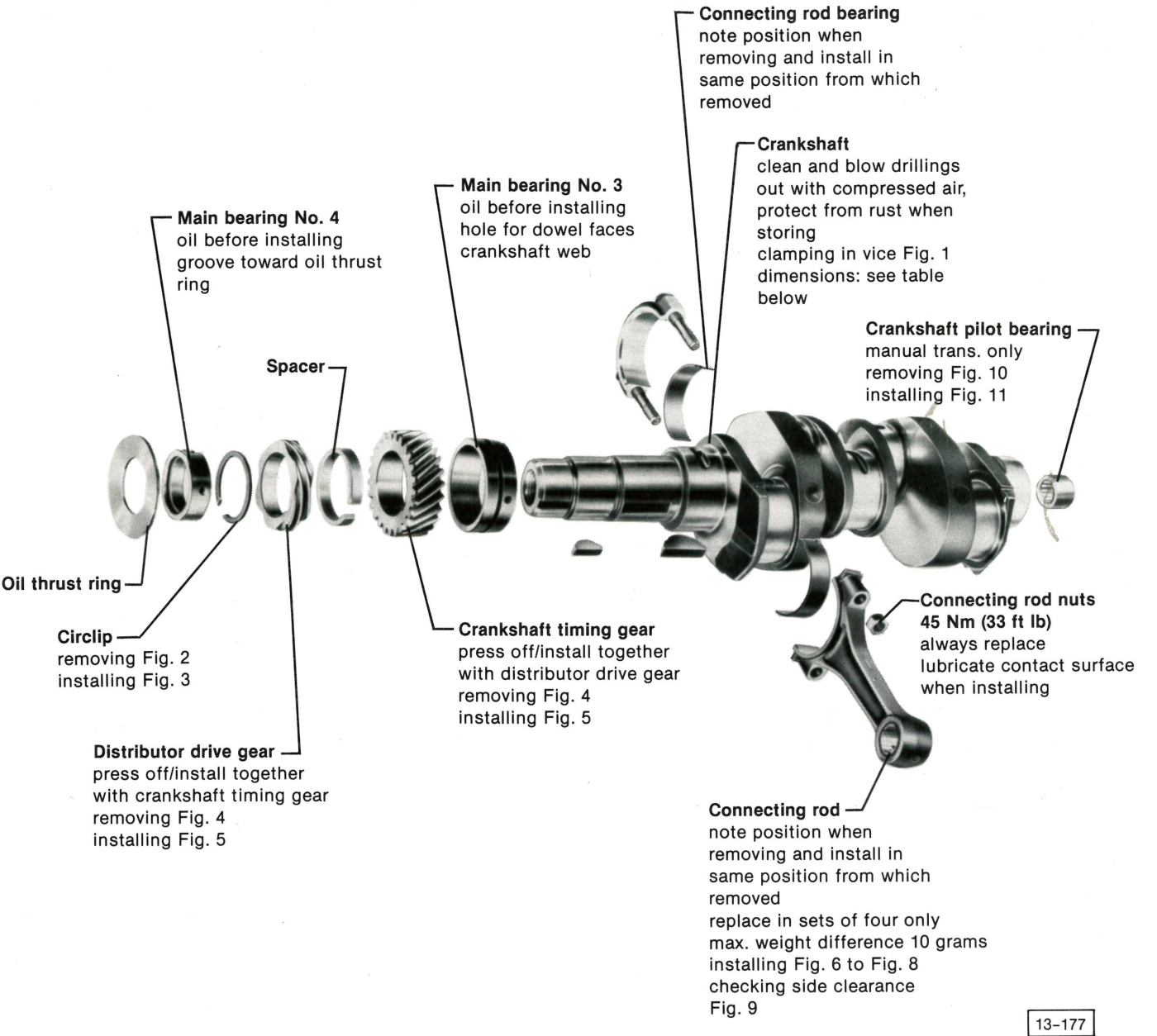


Fig. 5 Oil suction line with filter screen, replacing



Crankshaft journal sizes (mm)

	Bearing No. 1	Bearing No. 2	Bearing No. 3	Bearing No. 4	Connecting rod
Standard size	59.980–59.990 (marked: blue dot)	54.971–54.990	54.980–54.990 (marked: blue dot)	39.984–40.00	54.983–54.996
	59.971–59.979 (marked: red dot)		54.971–54.979 (marked: red dot)		

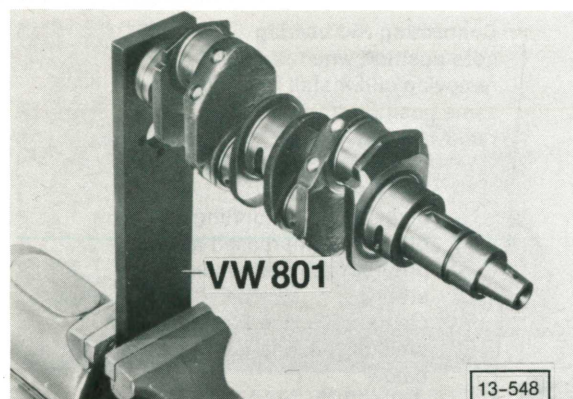


Fig. 1 Crankshaft, clamping in vise

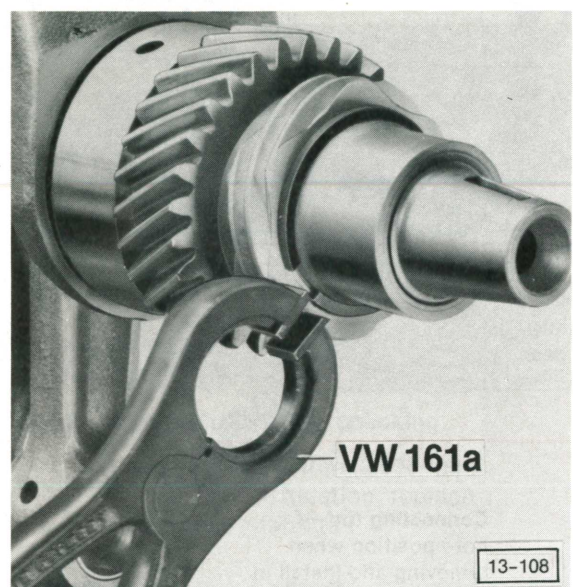


Fig. 2 Circlip, removing

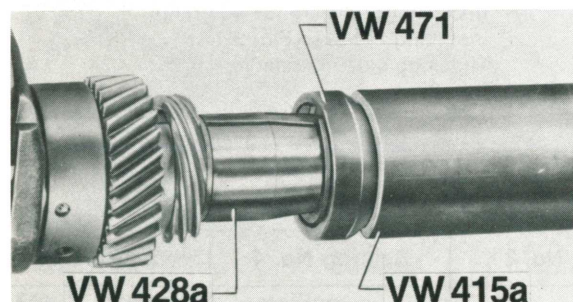


Fig. 3 Circlip, installing

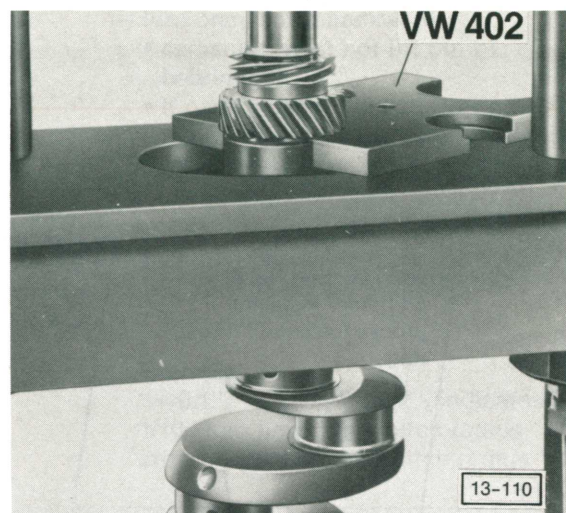


Fig. 4 Distributor drive gear/crankshaft timing gear, removing

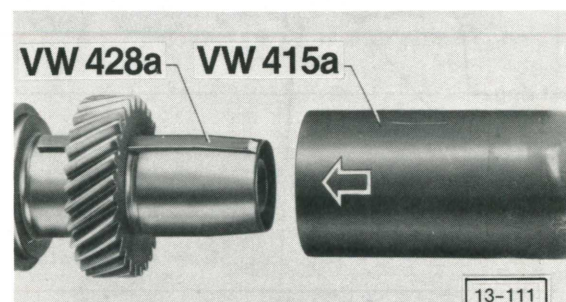


Fig. 5 Distributor drive gear/crankshaft timing gear, installing

— heat gears to approx. 80 °C (175 °F) before installing



Fig. 6 Connecting rod, installing

— numbers (arrow) on rod and cap must match and be on same side

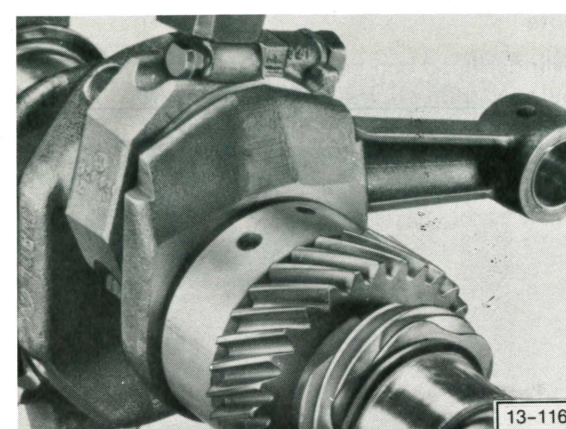


Fig. 7 Connecting rod, installing

— lightly tap both sides of connecting rod with hammer to eliminate slight pinching of bearing shells when installing connecting rod

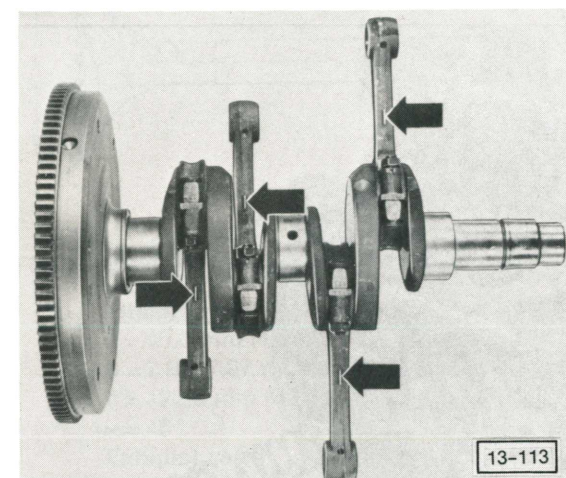


Fig. 8 Connecting rods, installation position

- forged mark on rods (arrows) must face up when rods are installed

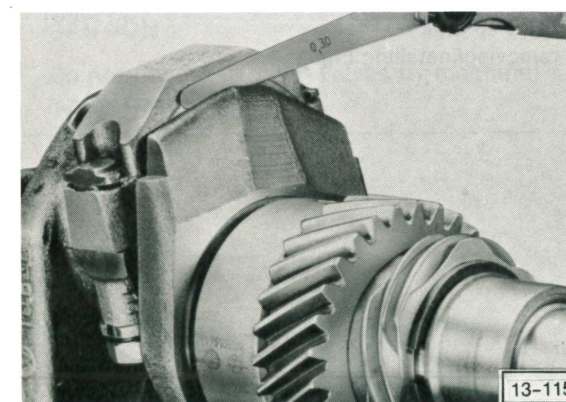


Fig. 9 Connecting rod, checking side clearance

- wear limit 0.7 mm (0.028 in.)

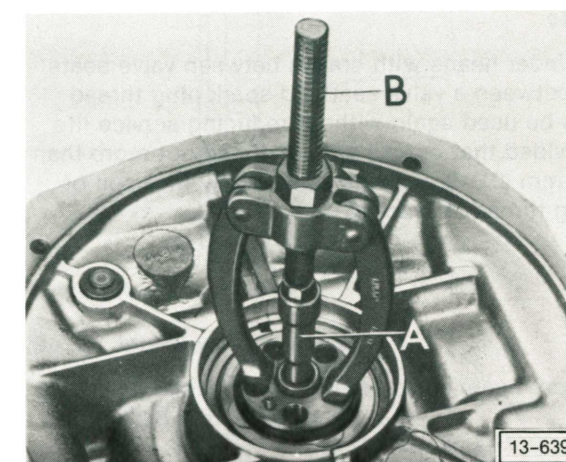


Fig. 10 Crankshaft pilot bearing, removing

A = US 8028

B = US 1039 & US 1039/3

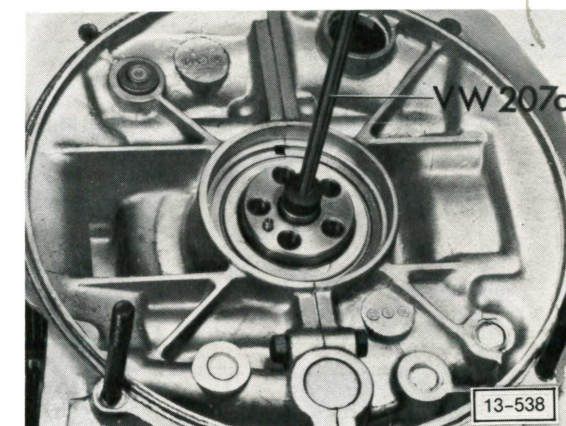


Fig. 11 Crankshaft pilot bearing, installing

- lubricate with MoS₂ grease when installing
- markings on bearing cage must face outward

Note

Cylinder heads with cracks between valve seats or between a valve seat and spark plug thread can be used again without reducing service life provided that cracks are small and not more than 0.5 mm (0.019 in.) wide or that only first coil of plug thread is cracked

Note

Cylinder head can be removed and installed with engine installed

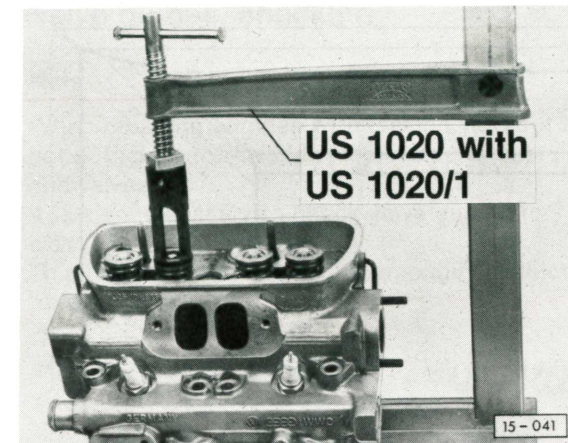
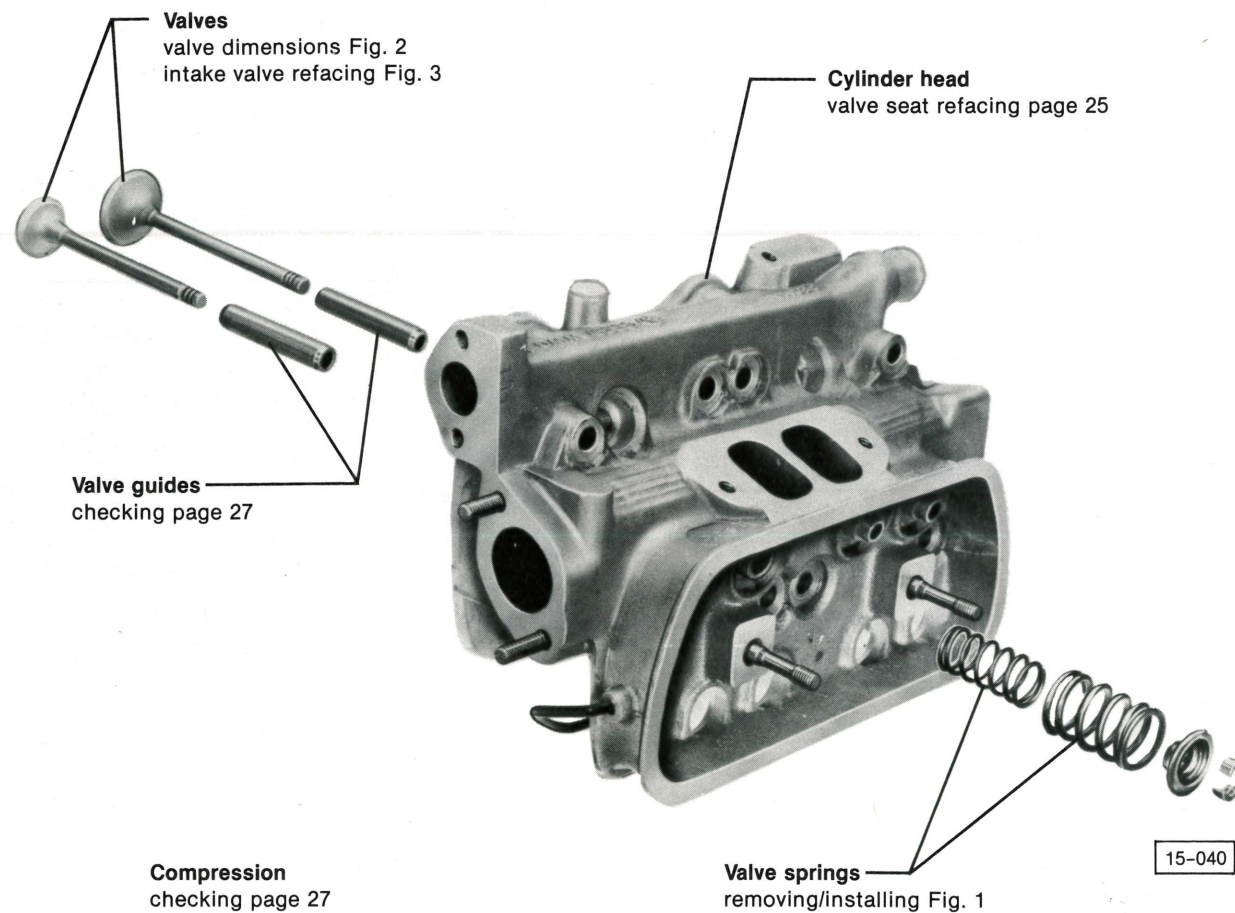


Fig. 1 Valve springs, removing/installing

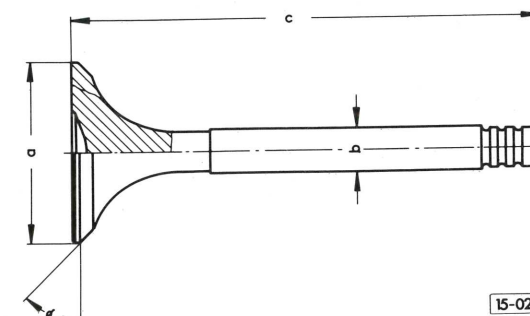


Fig. 2 Valve, dimensions

Intake valve

a = 40.0 mm (1.575 in.) diameter
b = 7.96-7.97 mm (0.313-0.314 in.) dia.
c = 122.5 mm (4.823 in.) length
 $\alpha = 45^\circ$

Exhaust valve

a = 34 mm (1.339 in.) diameter
b = 8.91-8.92 mm (0.3508-.3512 in.) dia.
c = 122.5 mm (4.823 in.) length
 $\alpha = 45^\circ$

CAUTION

Do not rework **exhaust valves** by machine, lap by hand only

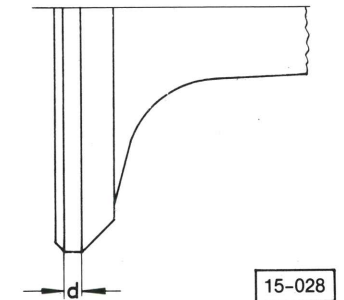
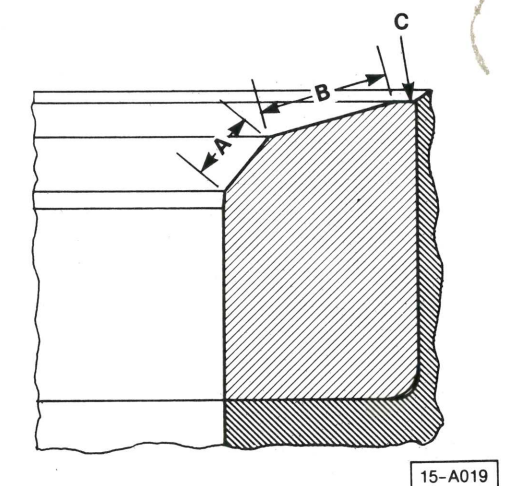


Fig. 3 Intake valves, refacing

- valve margin d must not be less than 0.5 mm (0.020 in.)

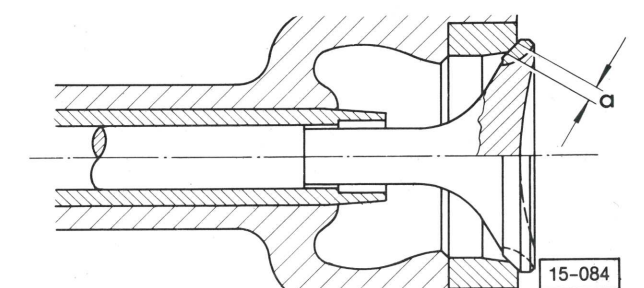
Valve seats, refacing

Work sequence

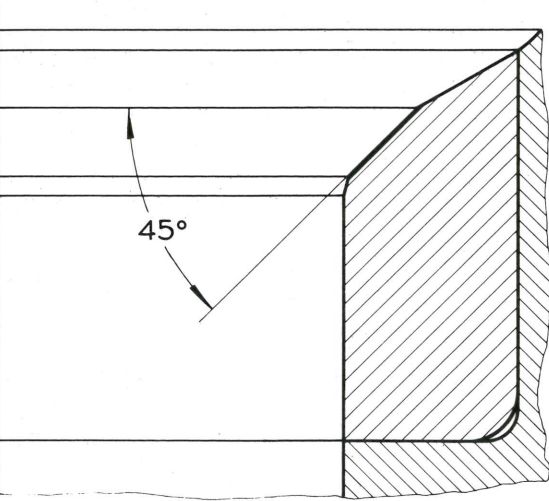


CAUTION

- Damaged or burnt seats can be refaced if:
- permissible width of seat A is maintained
 - 15° chamfer B does not exceed outer diameter of valve seat insert in cylinder head at C

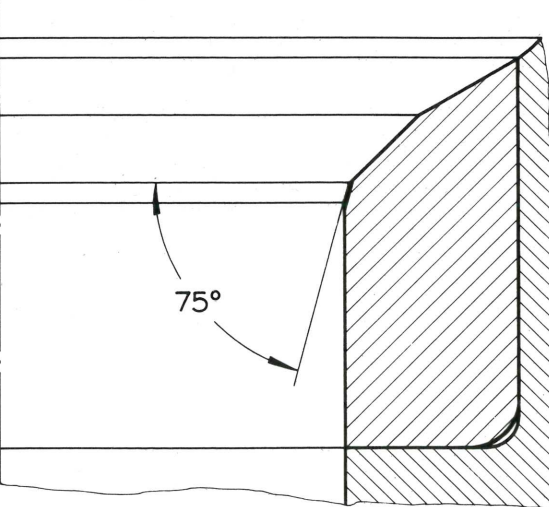


— seat width a = 1.4-2.5 mm (0.055-0.098 in.)



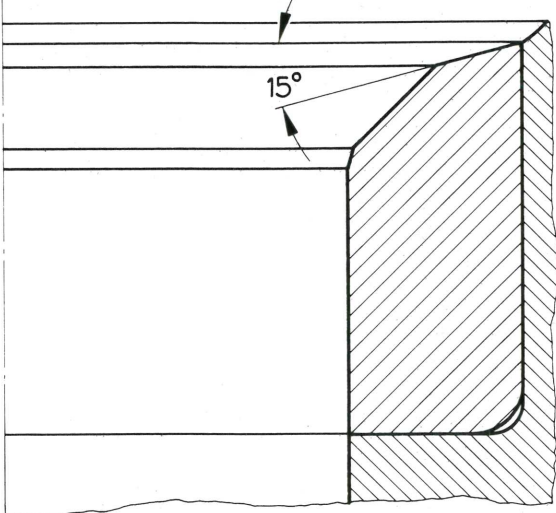
15-085

- reface valve seats to 45° angle
 - stop cutting as soon as complete seat is cleaned



15-086

- reface surface to 75° angle
 - slightly chamfer lower edge of valve seat



15-431

- reface surface to 15° angle
 - chamfer upper edge of valve seat until correct seat width is obtained

Note

When new valves are installed in properly reworked seats, it may not be necessary to lap in valves

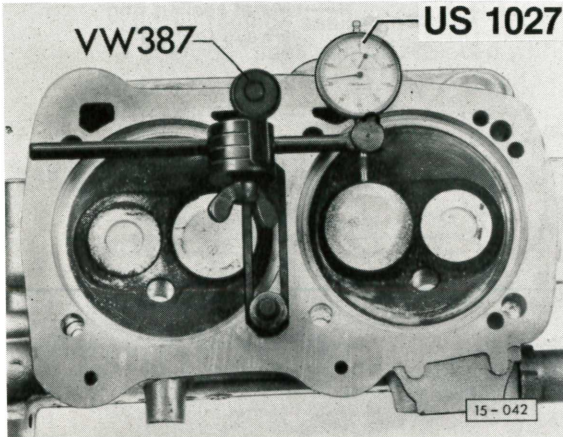
CAUTION

After lapping valve, remove all traces of grinding paste

Valve guides, checking

Note

When repairing engines with leaking valves it is not sufficient to rework or replace valve seats and valves.
It is also necessary to check valve guides for wear.
This is particularly important on engines which have considerable mileage.



- remove carbon
- insert new valve into valve guide
 - valve stem must be flush with valve guide end
- rock valve back and forth against dial indicator (arrow)
 - max. 1.2 mm (0.047 in.)

Compression, checking

- engine oil temperature minimum 30 °C (86 °F)
- throttle valve open fully (accelerator pedal in full throttle position)
- remove all spark plugs
- disconnect coil wire at ignition distributor and connect to ground with clamp



- check compression with tool US 1120
- operate starter until tester no longer indicates a rise in pressure
 - compression pressure: 10–13 bar (145–189 psi)
 - minimum: 8 bar (116 psi)
 - maximum pressure difference between highest and lowest cylinders: 3 bar (44 psi)

Note

Cylinder head can be removed and installed with engine installed

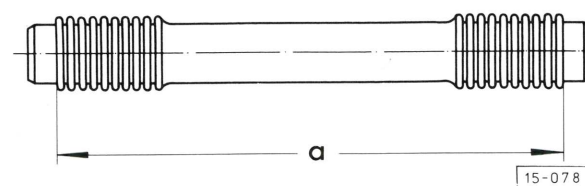
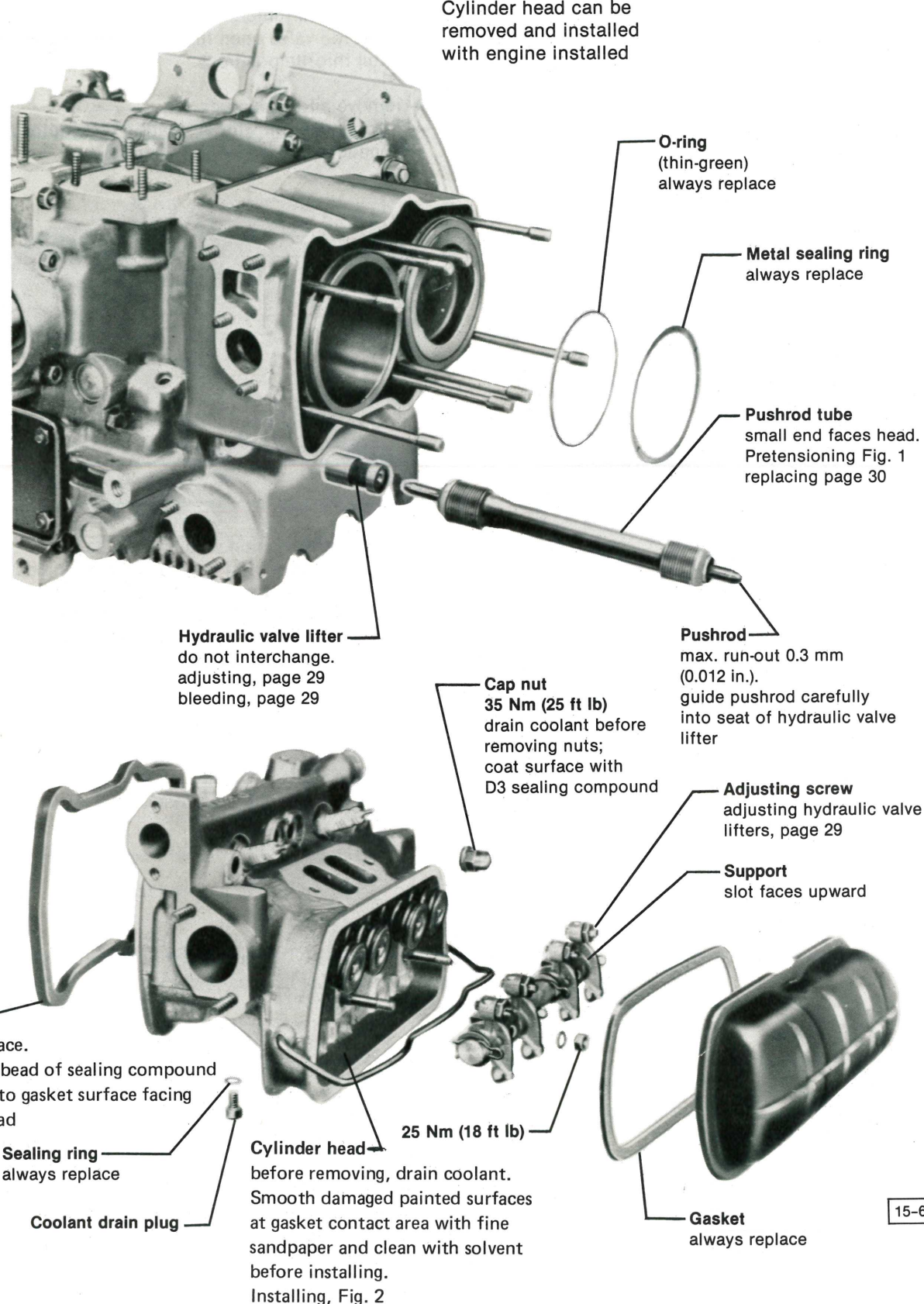


Fig. 1 Pushrod tube, pretensioning

- pretension tube to correct length
 - a = approx. 194 mm (7.638 in.)
- when installing, seam faces upward and small end to cylinder head
- always replace sealing rings
 - pushrod tubes can be replaced with engine installed

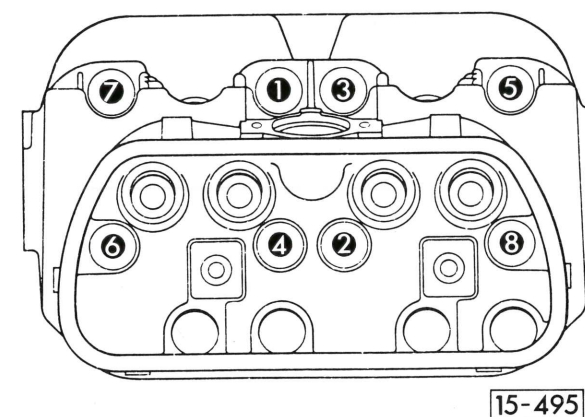


Fig. 2 Cylinder head, installing

- tighten cylinder head at stud 1 with cap nut just enough so that all remaining 7 cap nuts can be installed
- coat surface of cap nuts with D 3 sealing compound and torque (1st stage) in sequence to 10 Nm (7 ft lb)

Note

Be sure that pushrod tubes are properly seated

- tighten cap nuts to final torque 35 Nm (25 ft lb)

Hydraulic valve lifters, adjusting

Note

Never repair valve lifters; if worn or damaged, replace complete assembly.

Valve lifters can be removed and replaced without engine removal and without major engine disassembly.

Intermittent valve noises are normal upon starting, sudden acceleration, high temperatures or high engine speed

CAUTION

If metal particles are found in oil pan, remove, disassemble, clean and reinstall all valve lifters from position removed

Guide pushrod carefully into socket of hydraulic valve lifter

If rocker shafts have been removed, the following adjustment is necessary

Work sequence

- backout adjusting screws in rocker arms so that ball shaped end is flush with surface of arm
- turn crankshaft until cylinder No. 1 is at TDC (mark on rotor in line with mark on distributor housing)
- turn adjusting screws in so they just touch valve stems
- turn adjusting screws 2 turns clockwise and tighten locknuts
- rotate crankshaft 180° and adjust next cylinder
- repeat until all cylinders are adjusted

Hydraulic valve lifters, bleeding

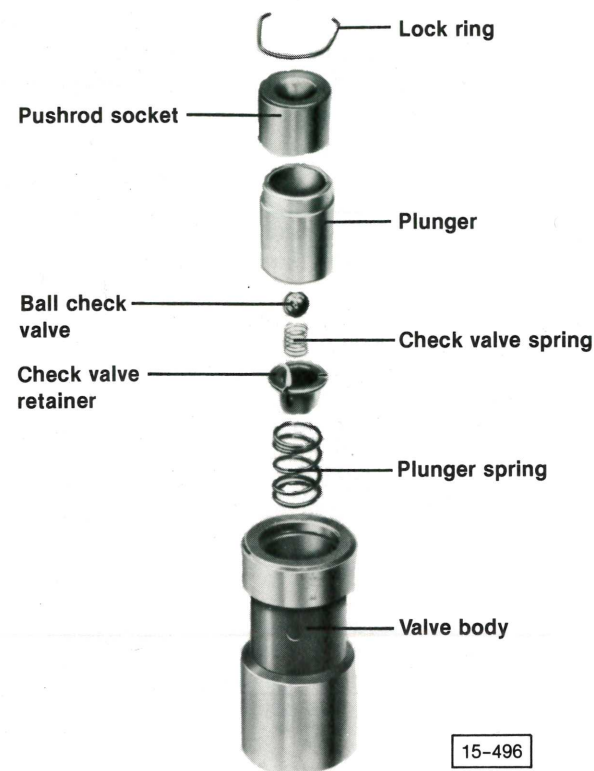
Work sequence



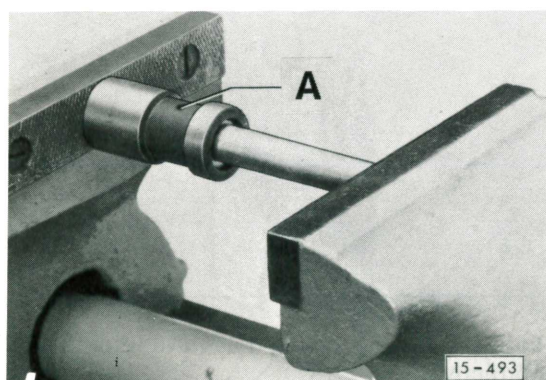
- before installing, check that valve lifter is bled correctly
 - check by applying firm thumb pressure on push rod socket in direction of arrow. Lifter should not move.

if NO, bleed lifter as follows:

Pushrod tube
Cylinder head
Hydraulic valve lifters



- pry out lock ring
- remove pushrod socket, plunger, ball check valve with spring, check valve retainer and plunger spring from body
- fill valve lifter body with oil up to bleed hole
- insert plunger spring
- install plunger with ball check valve, spring and valve retainer and push downward; at same time, open ball check valve with scribe



- insert pushrod in socket and slowly press together with valve guide or sawed-off pushrod in vise (bore a must face upward) or in press until lock ring can be installed
- install lock ring

Pushrod tubes, replacing

Note

Pushrod tubes supplied as replacement parts can be installed as follows with engine installed

Work sequence

- remove valve cover
- remove rocker arm shaft and pull pushrod out
- remove lower cover plate
- remove defective tube with pliers or screwdriver



- squeeze new pushrod tube together and insert with new sealing rings as shown (arrow) (tube seam faces upward, small end to head)
- insert pushrod and install rocker arm shaft

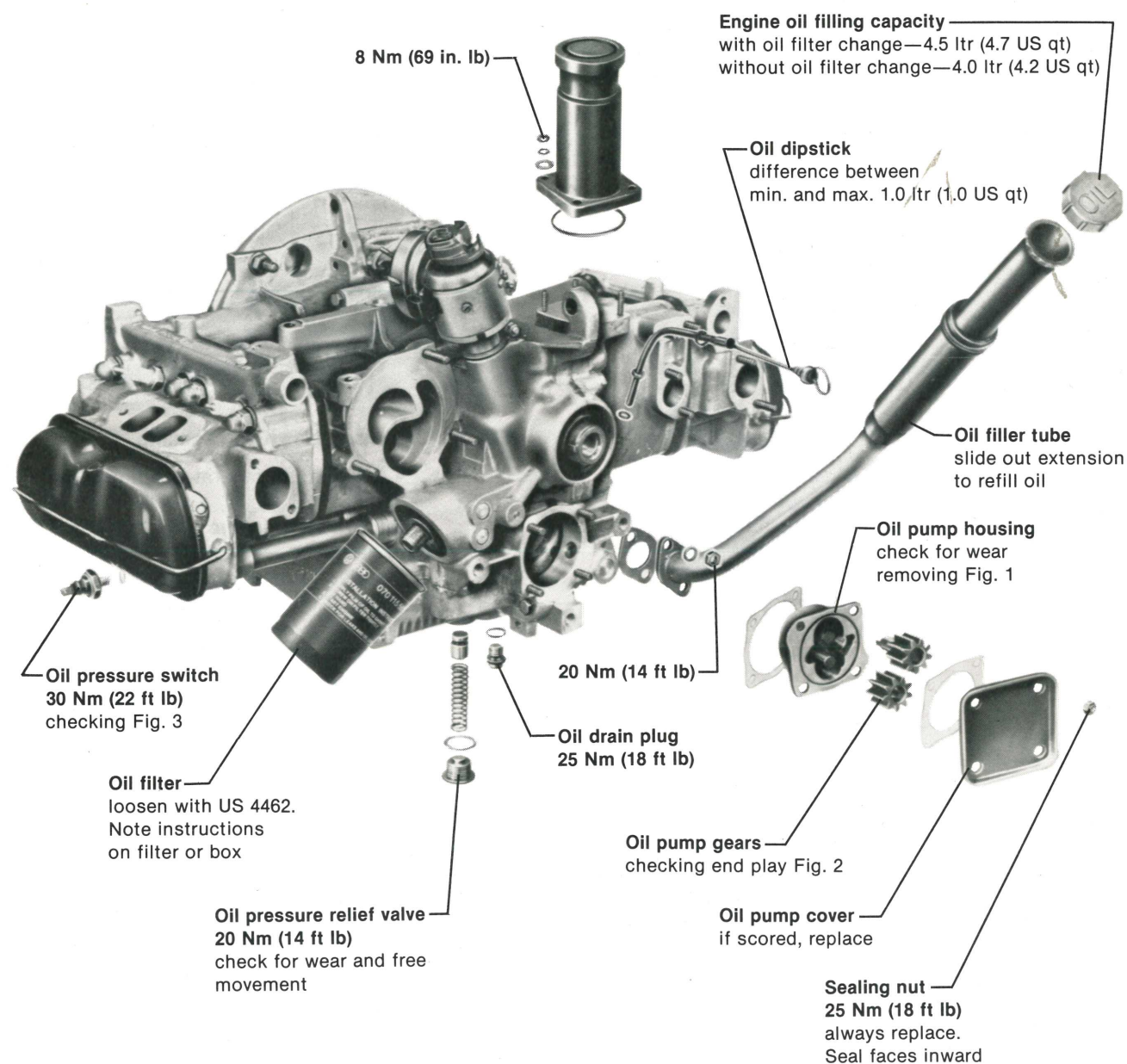
CAUTION

Guide pushrod carefully into seat of hydraulic valve lifter. If pushrod rests on edge of valve lifter basic setting will be incorrect and valve lifter will be damaged when engine is started

- adjust hydraulic valve lifters, see page 29

Note

Always replace all gaskets and sealing rings



Oil pump
Oil pressure switch
Oil filter

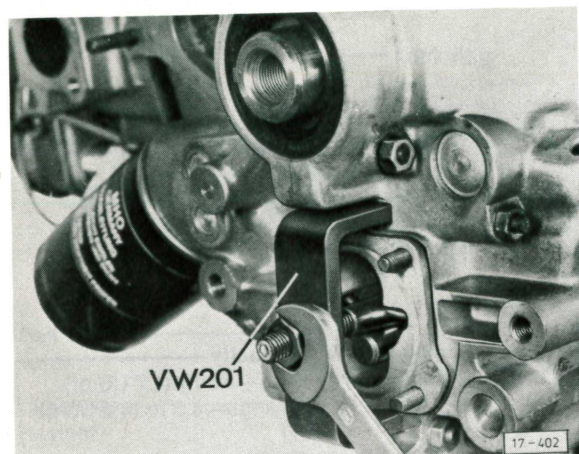


Fig. 1 Oil pump housing, removing

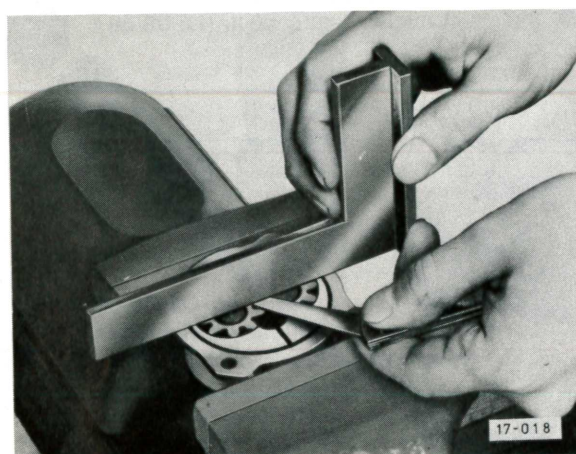


Fig. 2 Oil pump end play, checking

- max. 0.1 mm (0.004 in.)

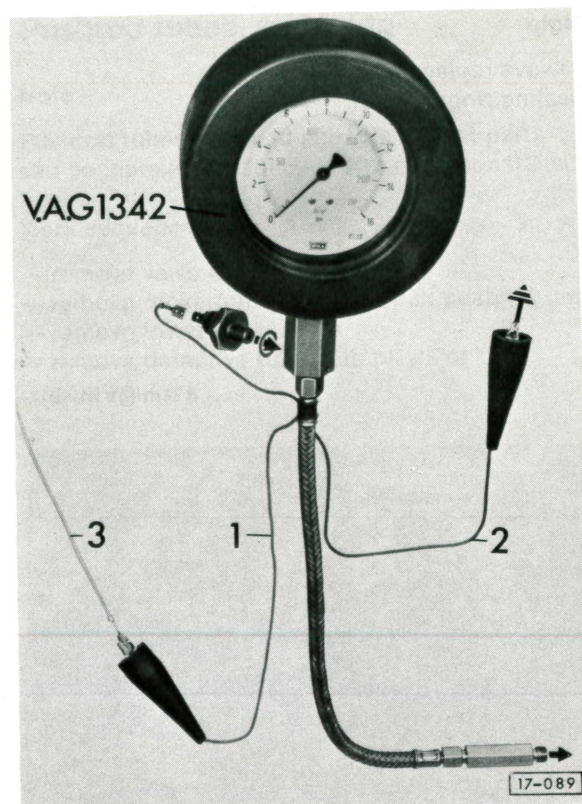


Fig. 3 Oil pressure/switch, checking

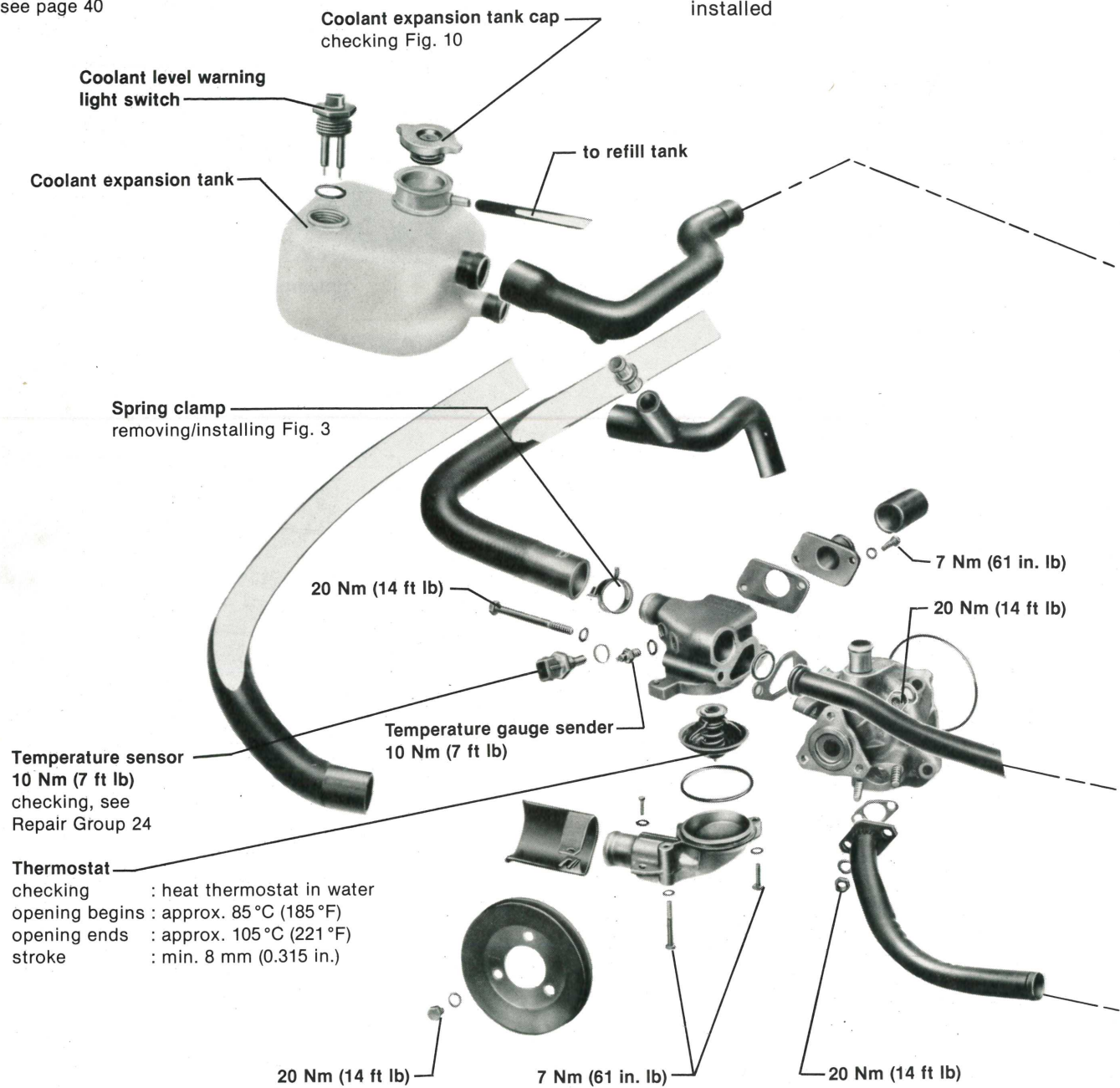
- engine oil temperature should be 80°C (176°F)
- remove oil pressure switch and install in gauge
- install oil pressure gauge/adaptor in place of oil pressure switch
- connect wire 1 (blue) of gauge to oil pressure switch and wire of oil pressure warning light 3 as shown
- connect wire 2 (brown) to ground
- turn ignition ON
 - oil pressure warning light must light up
- if **NO**, switch is defective, replace switch
- start engine
 - oil pressure warning light must go out at an oil pressure of 0.15-0.45 bar (2-6.5 psi)
- increase engine speed
 - at 2000 rpm, pressure should be minimum 2.0 bar (29 psi)

Notes

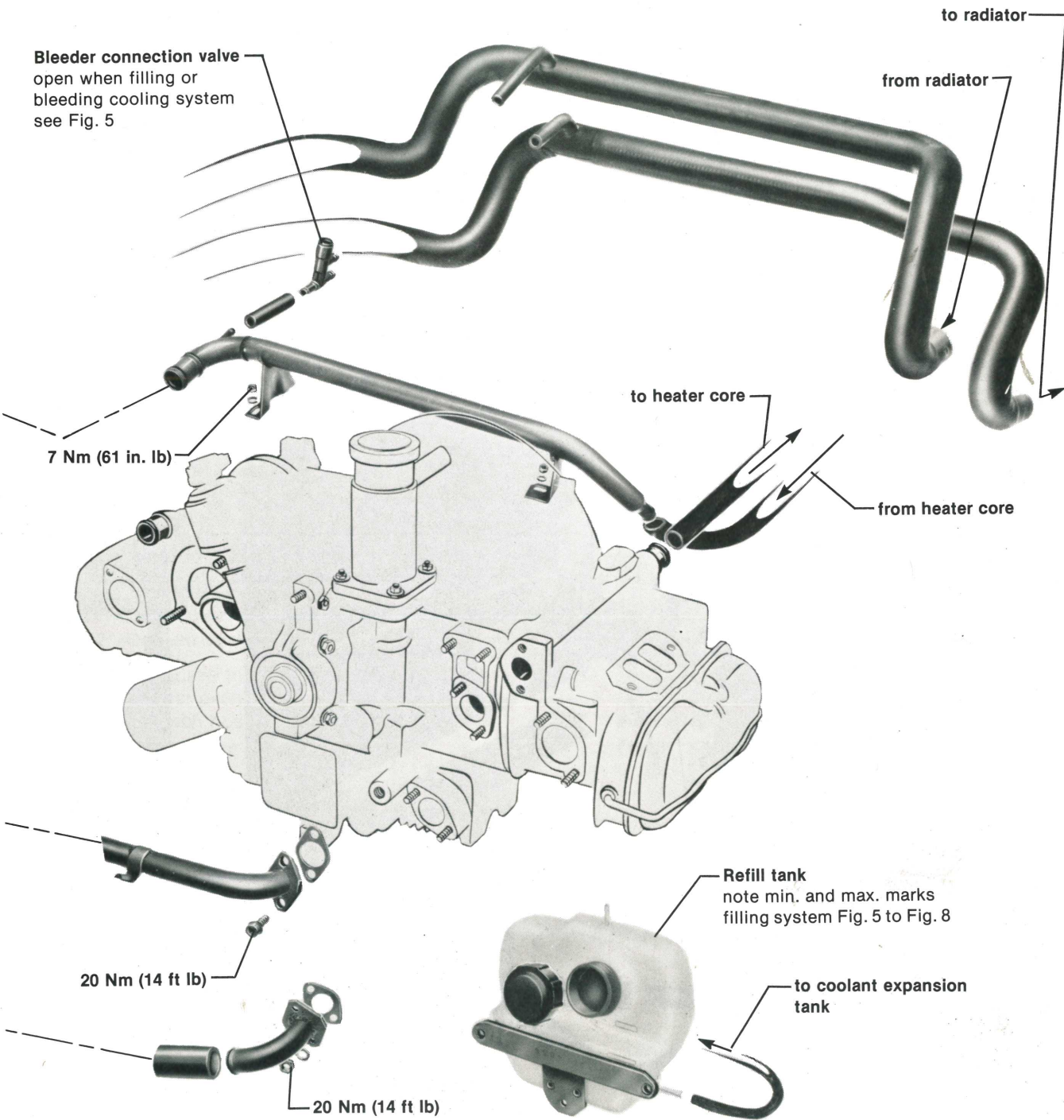
Cooling system
draining Fig. 1 to Fig. 4
checking for leaks Fig. 9

Cooling hoses layout
see page 40

Note
Always replace all gaskets.
All parts of cooling system can be
removed and installed with engine
installed



19-280



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Note

Cooling system is filled at factory with mixture of water and antifreeze/corrosion protective solution.
Coolant mixture should be used all year.
When replacing coolant only use ethylene glycol based antifreeze (phosphate-free).
Only use G11 coolant

Note

Secure coolant hoses with hose clamps

Thermo-switch for fan
(located at bottom of radiator)
removing/installing: remove radiator grille and move left cardboard air deflector to side

	I. stage	II. stage
cut-in temperature:	93°C–98°C (199–208°F)	99°C–105°C (210–221°F)
cut-out temperature:	88–93°C (190–199°C)	91–97°C (196–206°F)

Radiator

remove spare wheel bracket and radiator grille before removing or lowering radiator

Radiator fan

can be removed and installed without draining coolant after lowering radiator

Bleeder screw
open when filling cooling system, see Fig. 5

Washer

Lower bolts
remove bolts on both sides before lowering radiator

10 Nm (7 ft lb)

15 Nm (11 ft lb)

19-254

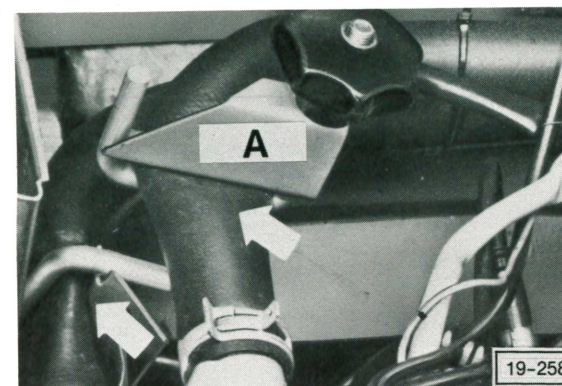


Fig. 1 Coolant system, draining (when removing engine)

— pinch coolant hoses with hose clamp (A-local supply) (arrows) before removing

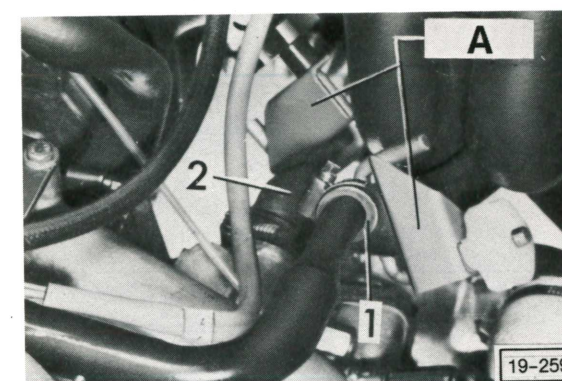


Fig. 2 Coolant system, draining

— in case that coolant hoses 1 and 2 for heat exchanger have to be removed, pinch hoses with hose clamp (A-local supply)

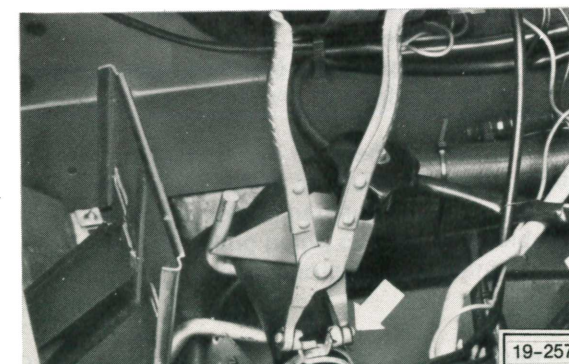


Fig. 3 Hose spring clamp, removing/installing

— use universal pliers or hose clamp pliers to remove or install clamp (arrow)



Fig. 4 Coolant system, draining

— open coolant expansion tank cap
— drain coolant at drain plugs 1 on cylinder heads

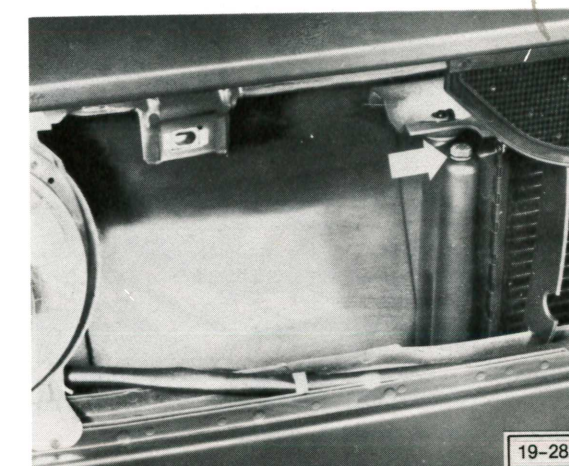


Fig. 5 Cooling system, filling

— set heater control to maximum heating
— open control valve for auxiliary heater under rear seat
— remove radiator grille
— raise vehicle approx. 40 cm (15 3/4 in.) at front under cross-member with floor jack and wooden support or equivalent
— open bleeder screw (arrow) on radiator

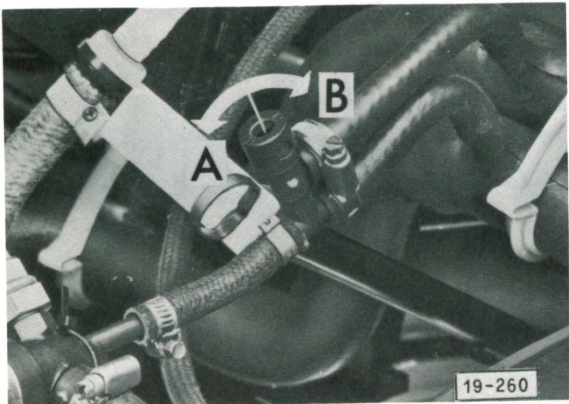


Fig. 6 Cooling system, filling

- open bleeder valve in engine compartment
- A = open
- B = closed

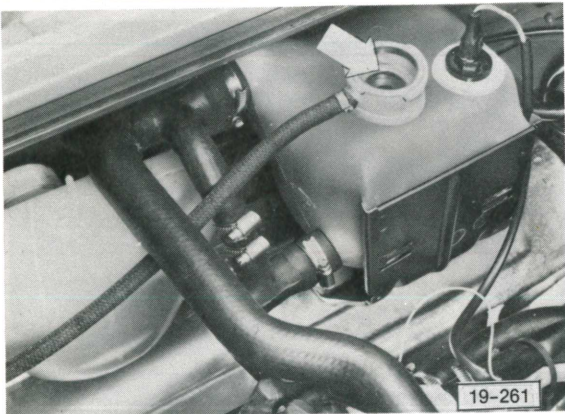


Fig. 7 Cooling system, filling

- fill coolant until expansion tank is full (approx. 4-5 ltr/4.25-5.3 US qt)
- start engine
- at approx. 2000 rpm, top up tank until coolant flows from bleeder screw on radiator (bubble free)
- add coolant until tank is full and close tank with cap
- turn ignition off and start engine again after approx. 20 seconds
- at about 2000 rpm open cap of expansion tank
- close bleeder screw on radiator when coolant flows out
- add coolant if necessary and close expansion tank
- switch engine off
- top up refill tank with coolant

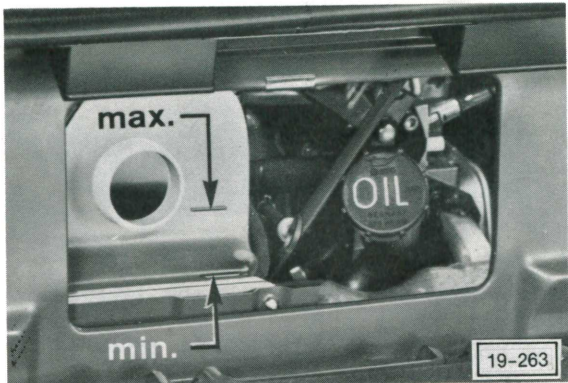


Fig. 8 Cooling system, filling

- fill refill tank up to max. mark (arrow)

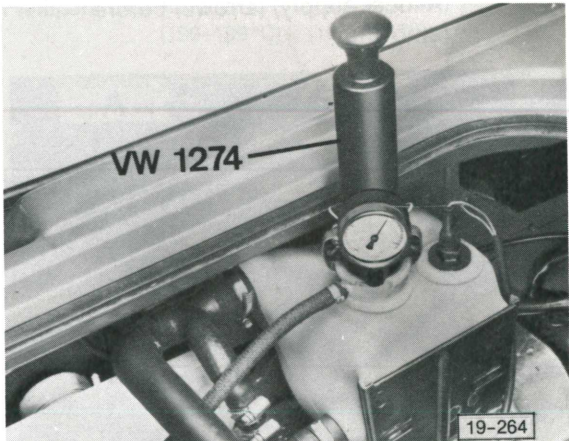


Fig. 9 Cooling system, checking for leaks

- attach tester in place of pressure cap
 - Stant tester St-255 A, AC-PCT3 or equivalent
- apply pressure of approx. 1 bar (14.5 psi)
 - if pressure remains constant, system is OK
 - if pressure drops, look for leaks and eliminate

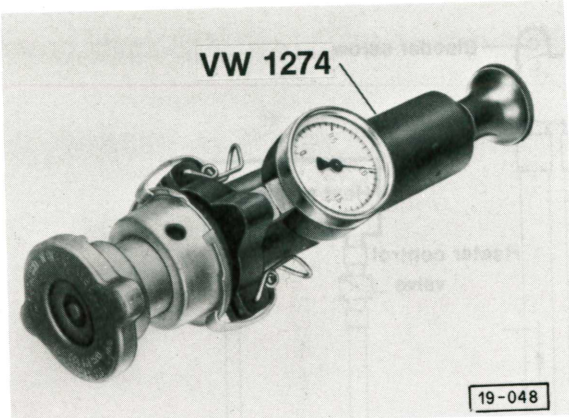


Fig. 10 Expansion tank cap, checking

- attach cap on tester
 - Stant tester ST-255 A, AC-PCT-3 or equivalent
- apply pressure of 0.9 to 1.15 bar (13-17 psi)
 - if pressure relief valve opens within this range, cap is OK

Note

Cap has 3 important functions:

1. it opens at pressure of 0.9-1.15 bar (13-17 psi) allowing flow to expansion tank
2. it opens at a vacuum of 0.02-0.1 bar (0.3-1.45 psi) allowing flow from expansion tank
3. it seals radiator neck

Only item 1 can be checked with tester.

If it is suspected that items 2 and 3 are not in order, replace cap

Coolant mixture ratio

- coolant capacity 17.5 ltr (18.4 US qt)

Note

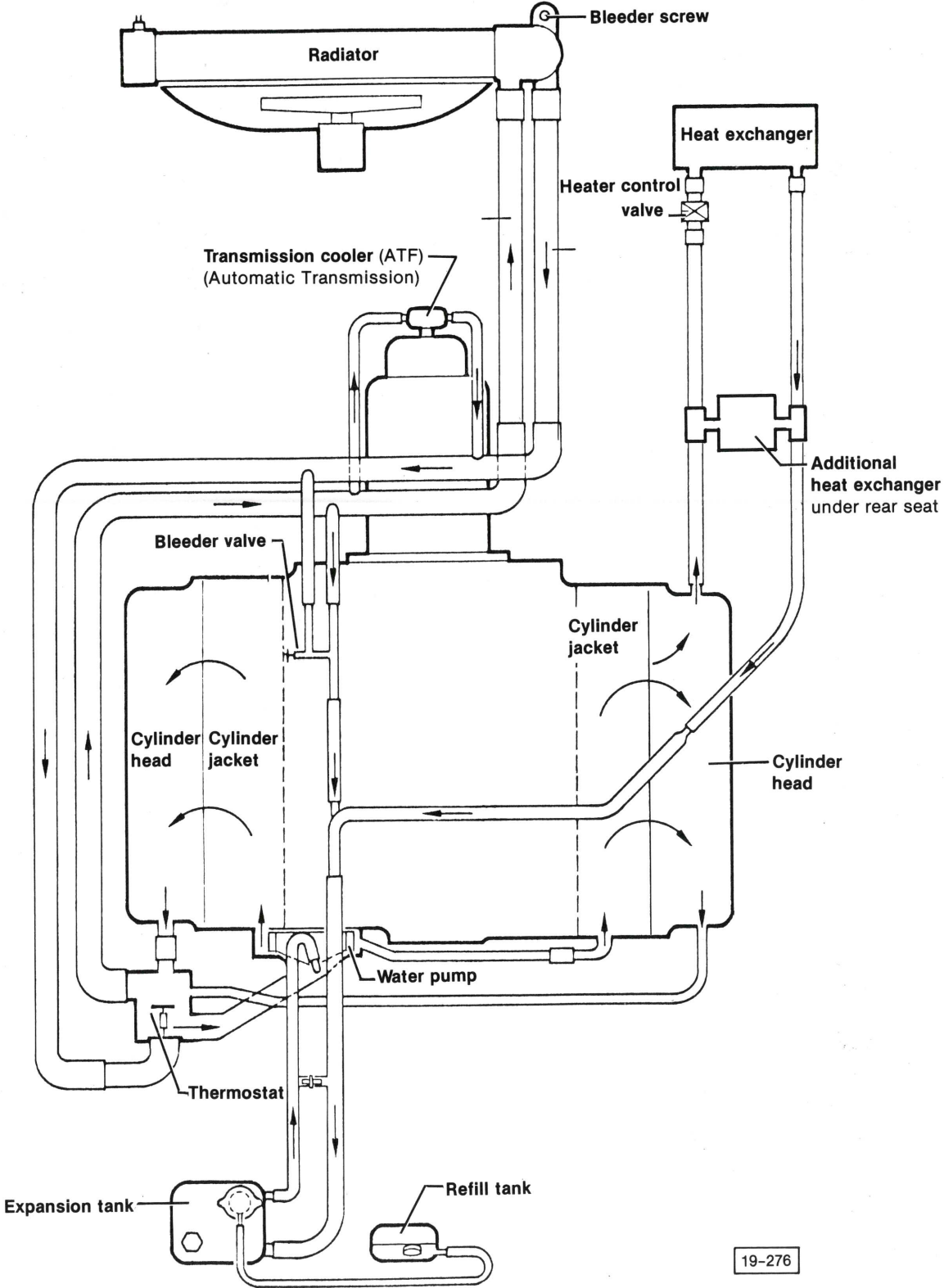
Cooling system is filled at factory with mixture of water and antifreeze/corrosion protective solution.

Coolant mixture should be used all year.

When replacing coolant only use ethylene glycol based antifreeze (phosphate-free).

Due to higher boiling point, coolant is an aid to operating on full load, particularly in warm climates

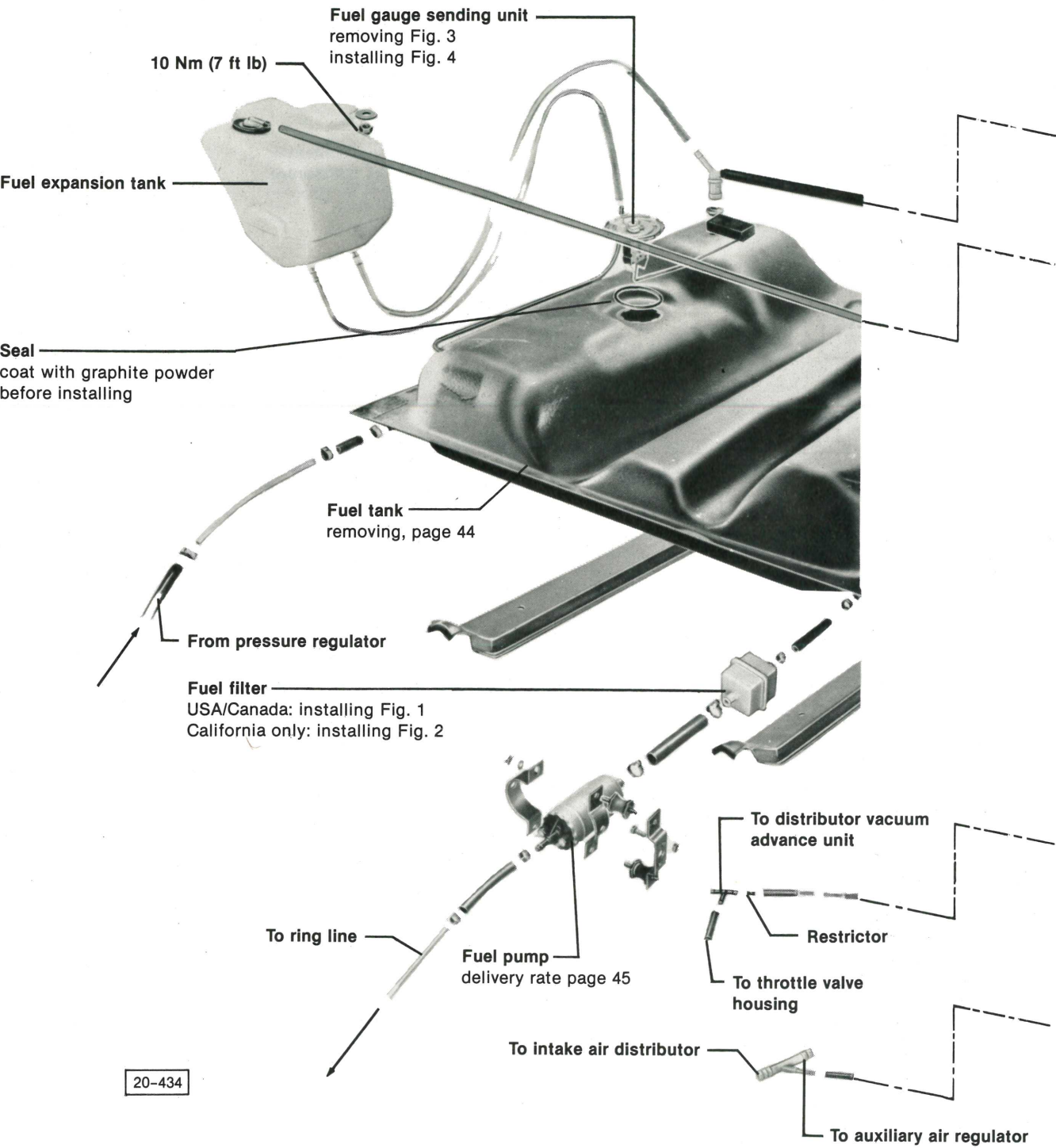
Outside Temperature	Antifreeze	Water
- 25 °C (- 13 °F)	7.0 ltr (7.4 US qt)	10.5 ltr (11 US qt)
- 35 °C (- 30 °F)	8.75 ltr (9.2 US qt)	8.75 ltr (9.2 US qt)



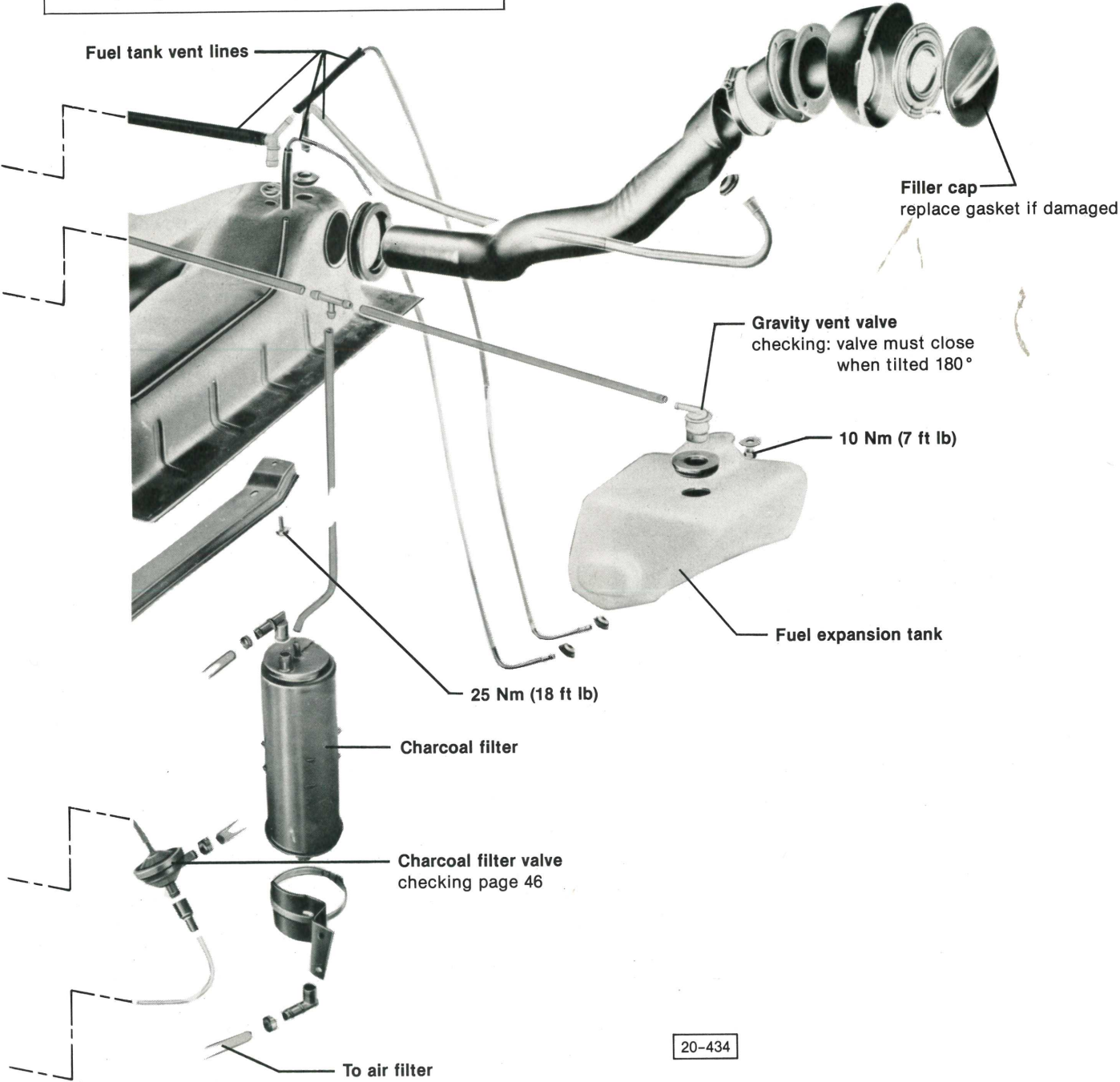
19-276

Notes

Fuel system
checking for leaks, see
page 47



WARNING
Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it.
Always replace seals and fuel hose clamps



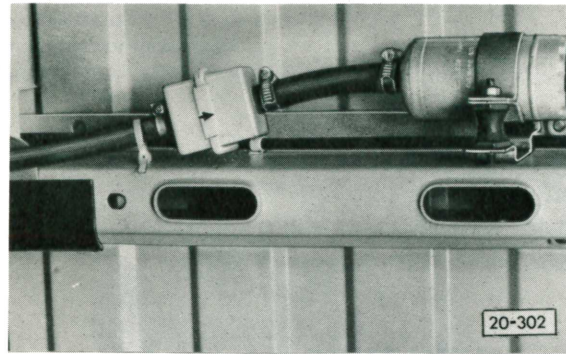


Fig. 1 Fuel filter, installing (USA and Canada)

- arrow on filter faces toward fuel pump

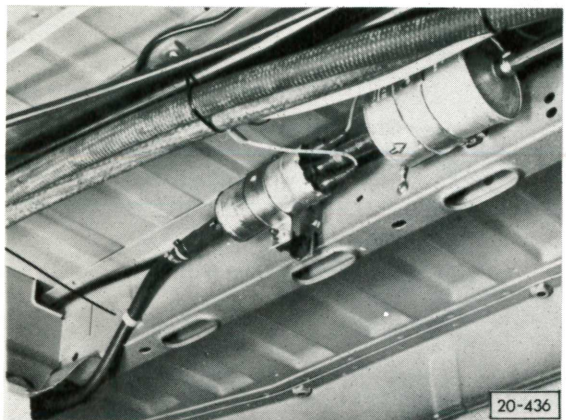


Fig. 2 Fuel filter, installing (California only)

- arrow on filter faces toward engine

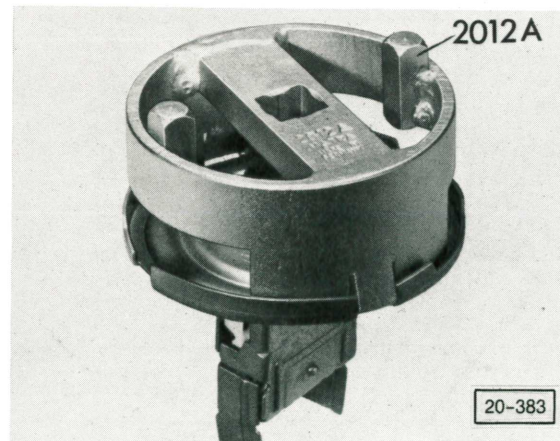


Fig. 3 Fuel gauge sending unit, removing

- before removing unit, remove fuel tank

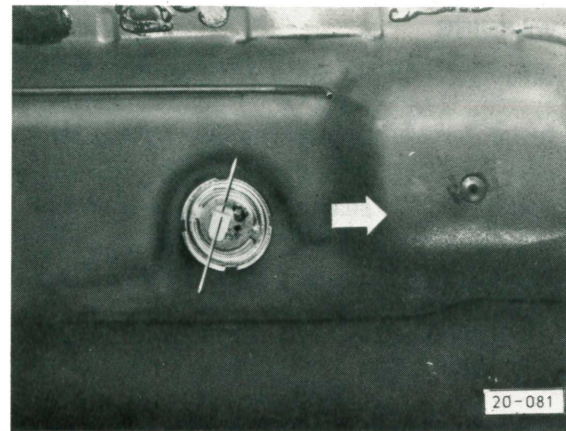


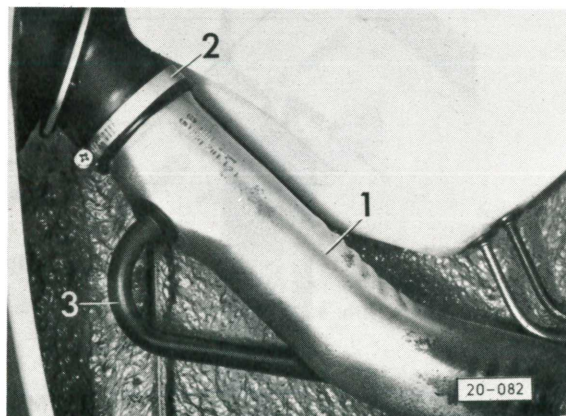
Fig. 4 Fuel gauge sending unit, installing

- coat seal with graphite powder and position carefully
- install sending unit so that electrical connector is aligned with dotted line
- arrow points to front of vehicle

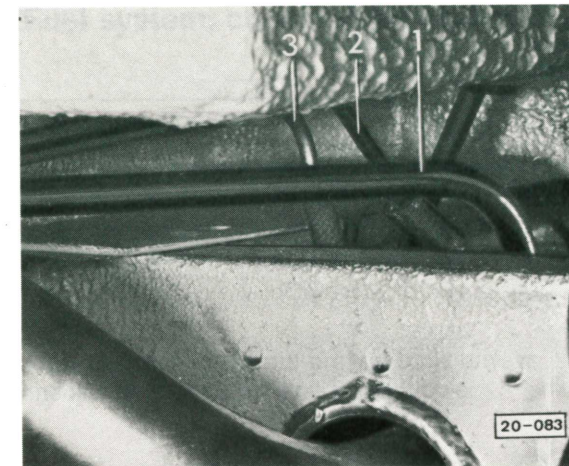
Fuel tank, removing

Work sequence

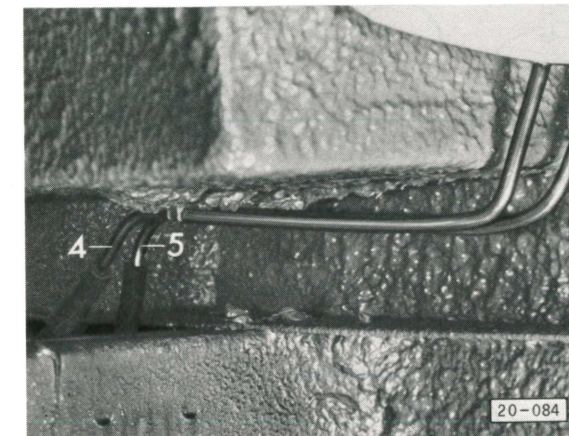
- disconnect battery ground strap
- drain fuel tank



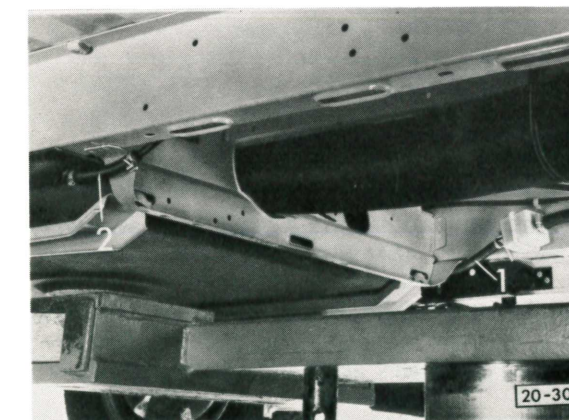
- loosen clip 2 on filler elbow
- remove filler pipe 1 and pull out breather pipe 3
- go to next page



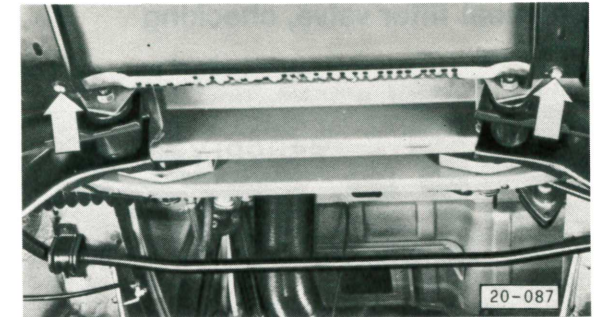
- remove vent hoses (on right) 1, 2 and 3



- remove vent hoses 4 and 5



- remove fuel supply hose 1 and fuel return hose 2 from fuel tank



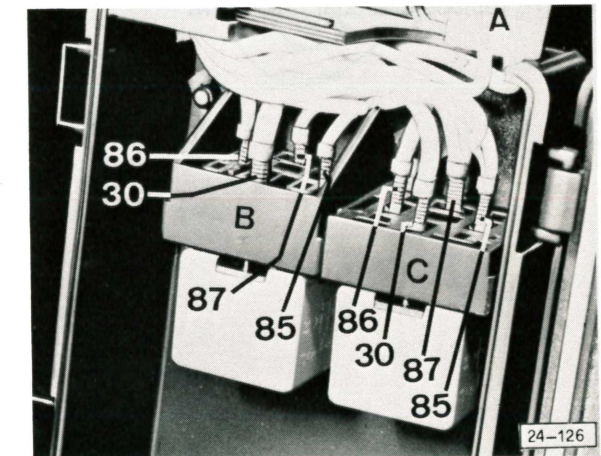
- loosen bolts on fuel tank mounting rails (white arrows) and remove rails from rear channel
- lower fuel tank and disconnect electrical connector on fuel gauge sending unit
- remove fuel tank

Fuel pump delivery rate, checking

Work sequence

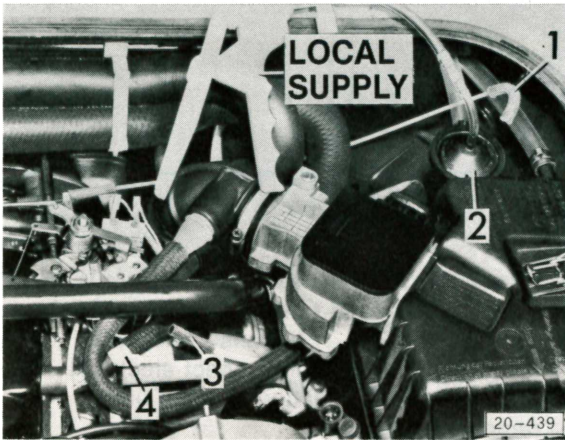
WARNING

Fire hazard! Never smoke or have anything in area that can ignite fuel



- disconnect fuel return line at pressure regulator and block line
- attach hose to return line fitting on pressure regulator and place other end of hose in one quart measuring container
- remove relay C
- connect terminals 30 and 87 with tester US 4480/3
- switch on for 30 seconds
- minimum fuel delivery rate should be 500 cm³

Charcoal filter valve, checking



- disconnect hose 1 from charcoal filter valve 2
- connect vacuum pump to filter valve connection instead of hose 1
- disconnect hose 3 from T-piece 4
- operate vacuum pump and suck with mouth on hose 3
 - filter valve must be **open**
- **without** operating vacuum pump suck with mouth on hose 3
 - filter valve must be **closed**

If NOT, replace charcoal filter valve

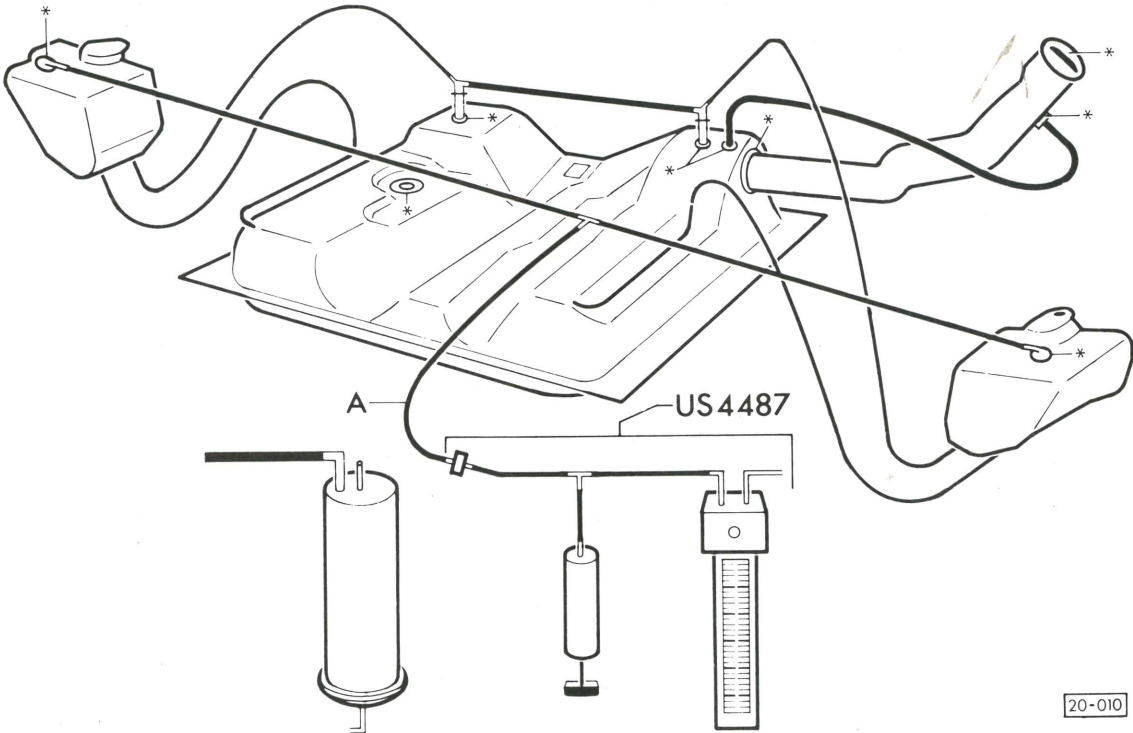
Fuel system, checking for leaks

WARNING

Disconnect battery when working on fuel system. Never smoke when working with fuel or have anything in area that can ignite it

Note

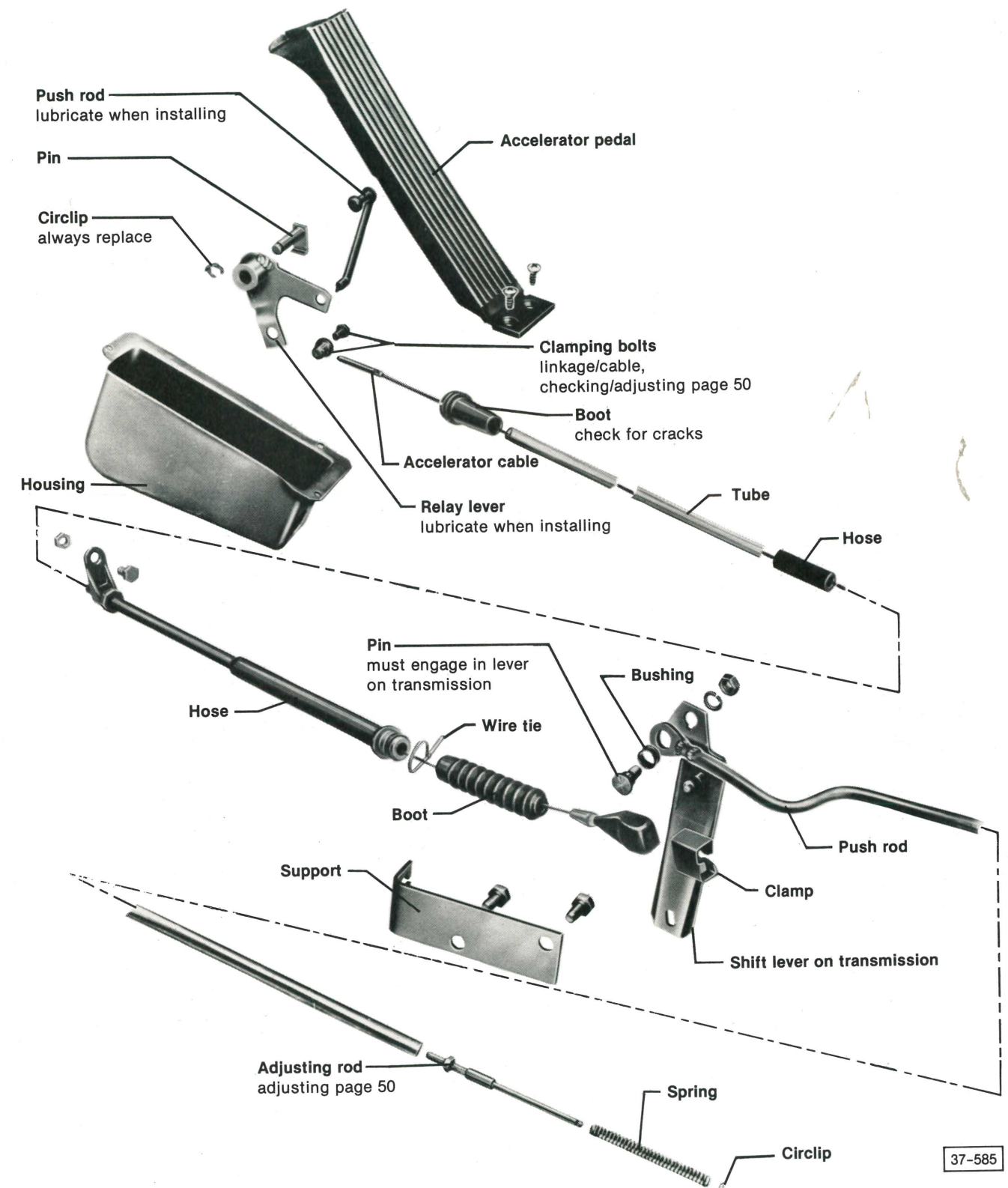
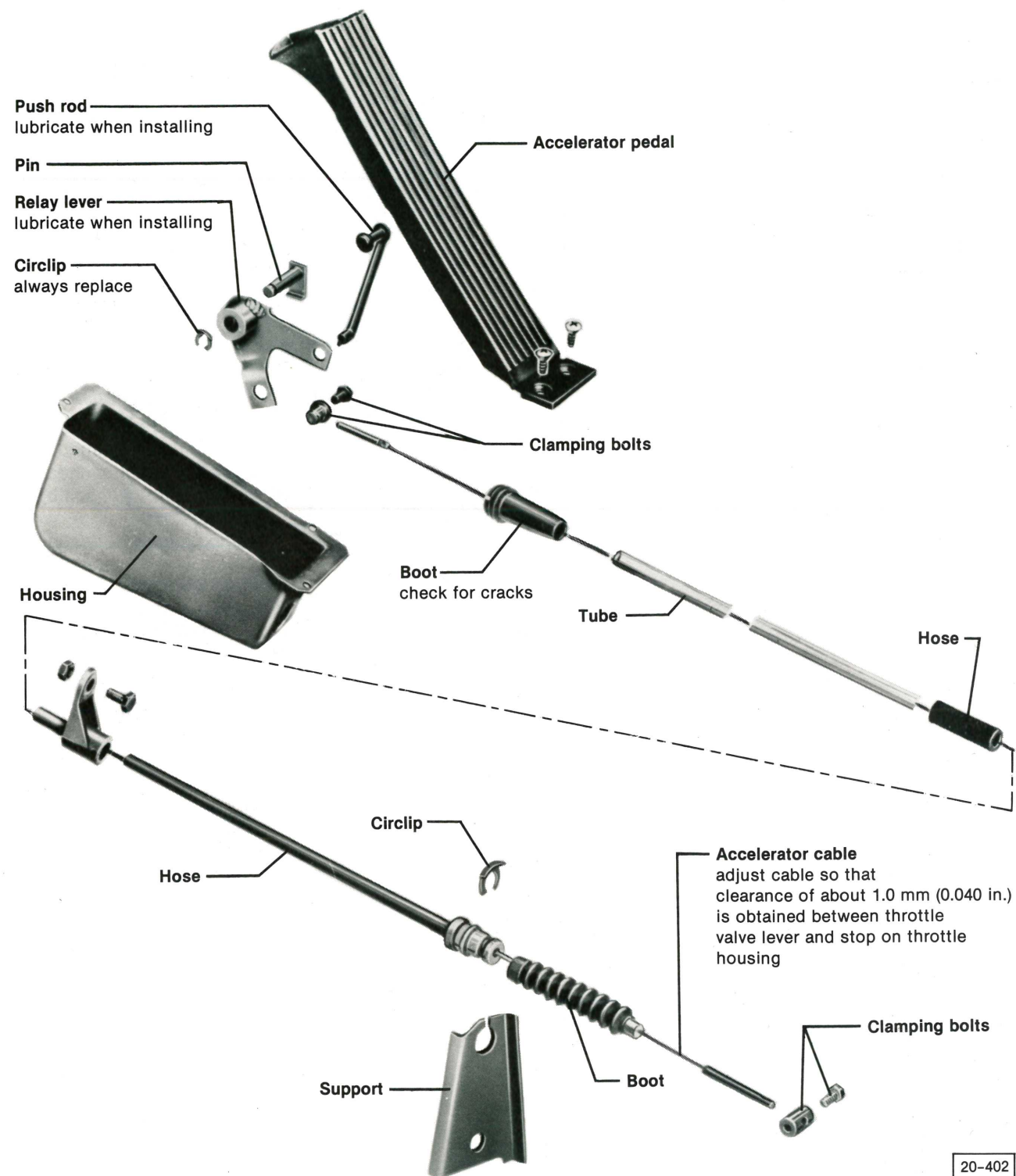
After performing repairs on fuel tank, always check fuel system for leaks as follows:



- Work sequence**
- remove small hose A at charcoal filter and connect to leak tester US 4487
 - set leak tester scale to "0"
 - pressurize system with hand pump to 3.3 cm of mercury
 - system OK if pressure is 2.54 cm or greater after 5 minutes
 - system leaking if pressure drops below 2.54 cm after 5 minutes

Note

Check system for leaks using soap solution at spots marked with *. Seal if necessary



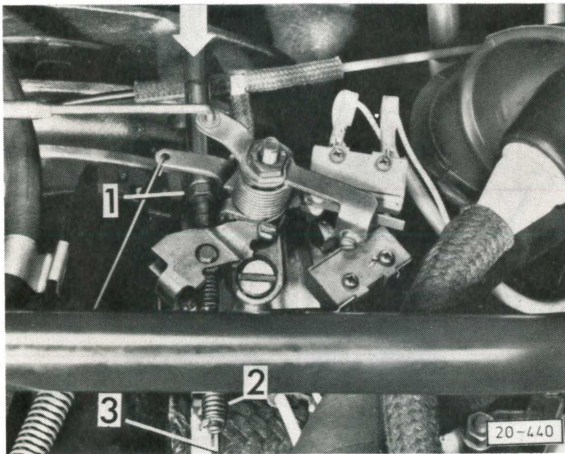
Accelerator linkage/cable adjustment, checking
(automatic transmission)

Work sequence

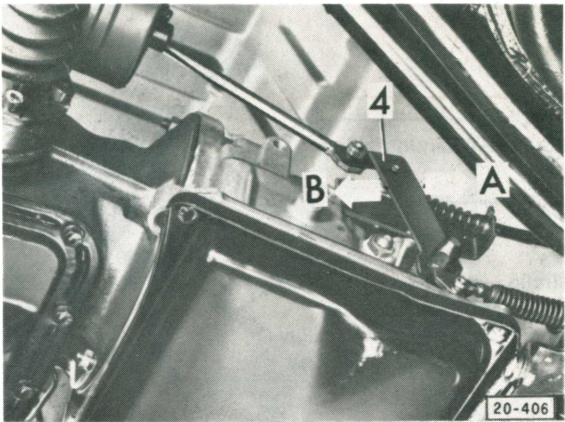
- depress accelerator pedal to full throttle position
 - throttle valve lever must contact stop, but kickdown lever on transmission must **not** be in kickdown position
 - press accelerator pedal beyond full throttle to floor
 - override spring must be tensioned and kickdown lever on transmission must be in kickdown position
- if **NO**, adjust as follows:

Accelerator linkage/cable, adjusting
(automatic transmission)

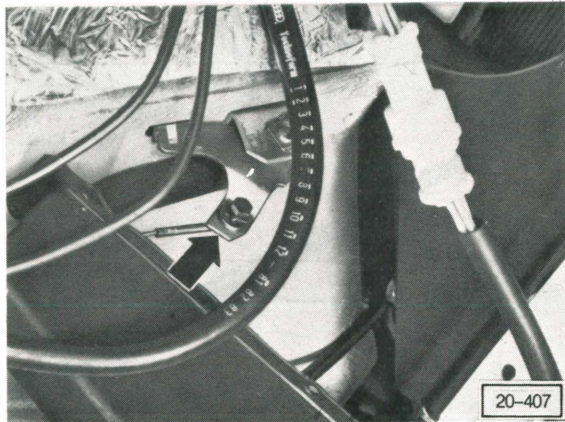
Work sequence



- loosen nut 1
- remove override spring 2
- start engine and let idle
- adjust idle speed at screw (see Repair Group 24)
- shut engine **OFF**
- press accelerator rod in direction of arrow to stop
- turn adjusting rod 3 with screwdriver until shoulder of adjusting rod just contacts pivot of throttle lever
- reinstall override spring 2
- start engine and check idle speed
 - adjust if necessary by turning rod 3
- lock adjusting rod 3 in position with nut 1



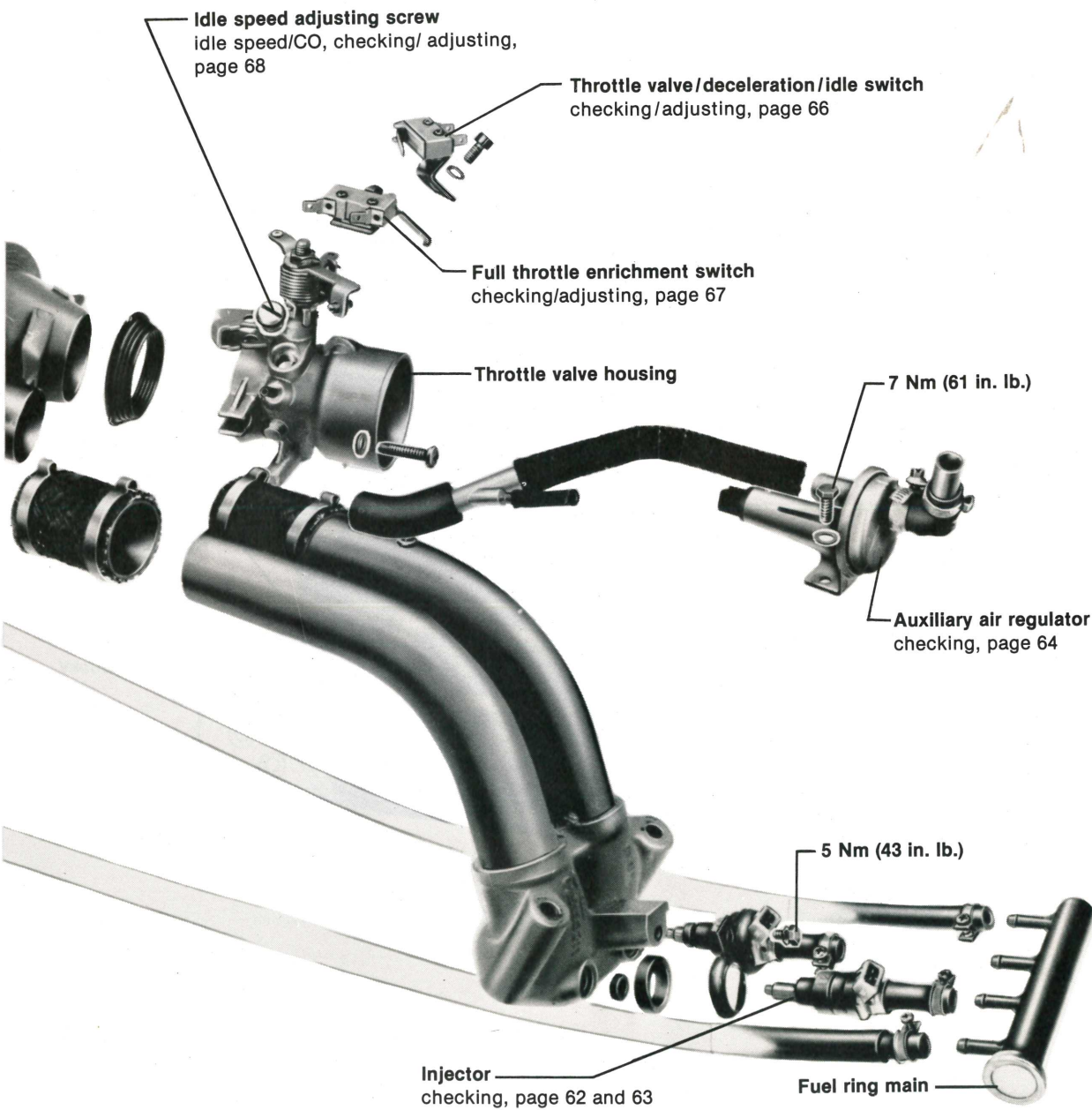
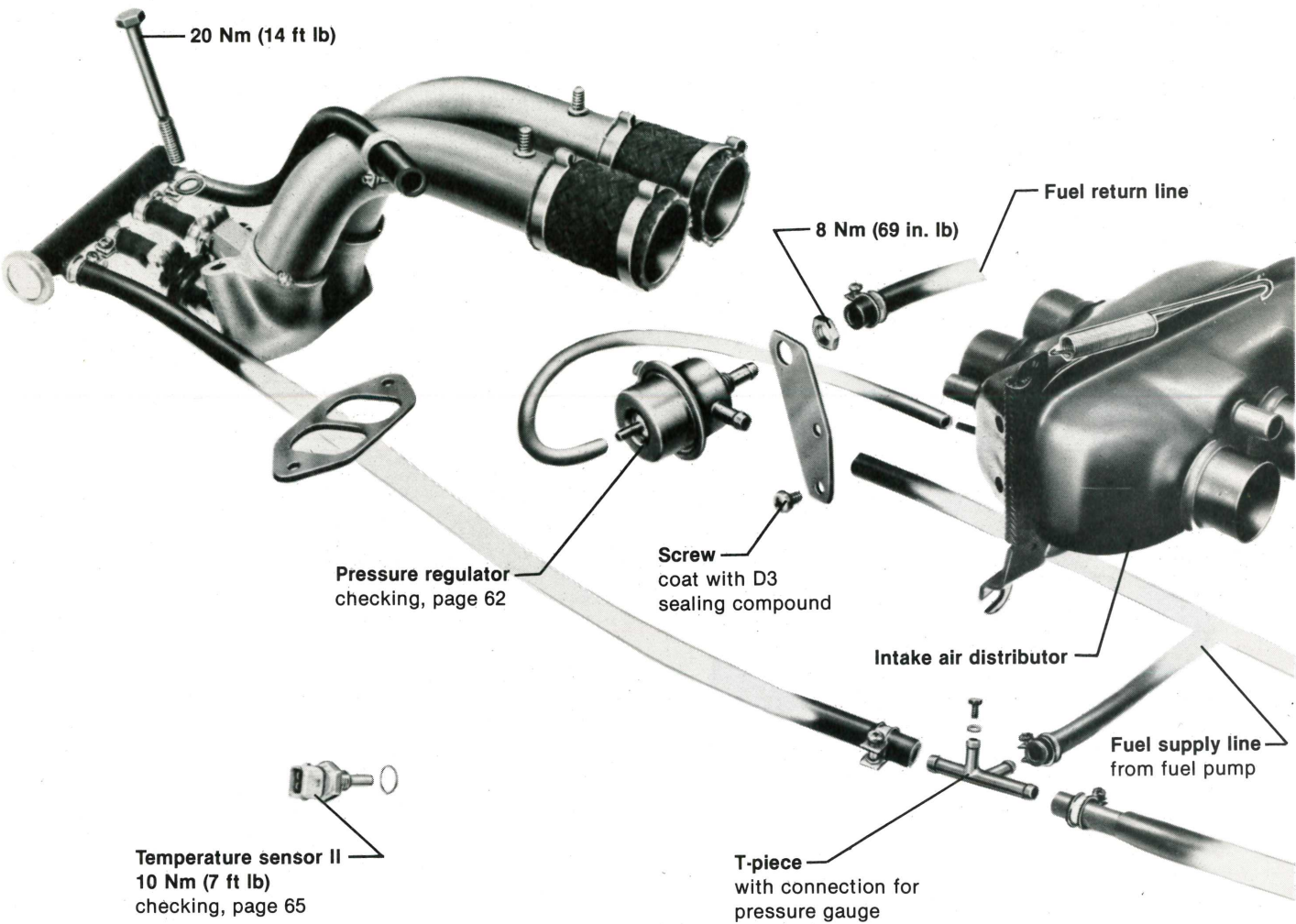
- press accelerator pedal to floor
 - lever 4 must be on stop in kickdown position (arrow A)
- release accelerator pedal
- lever must be in idle position (out of kickdown) (arrow B)

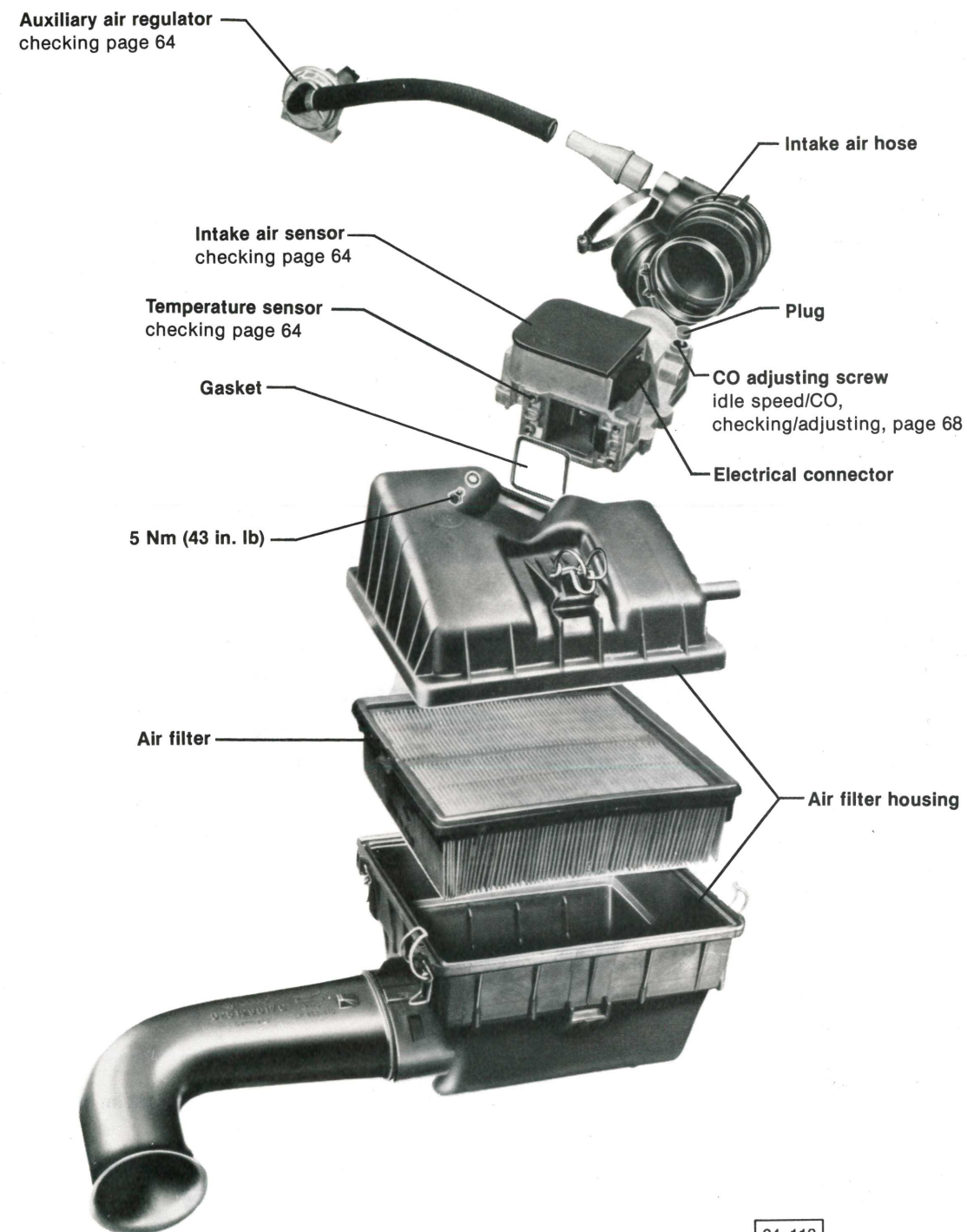


- if necessary, adjust accelerator cable at clamping bolt (arrow)

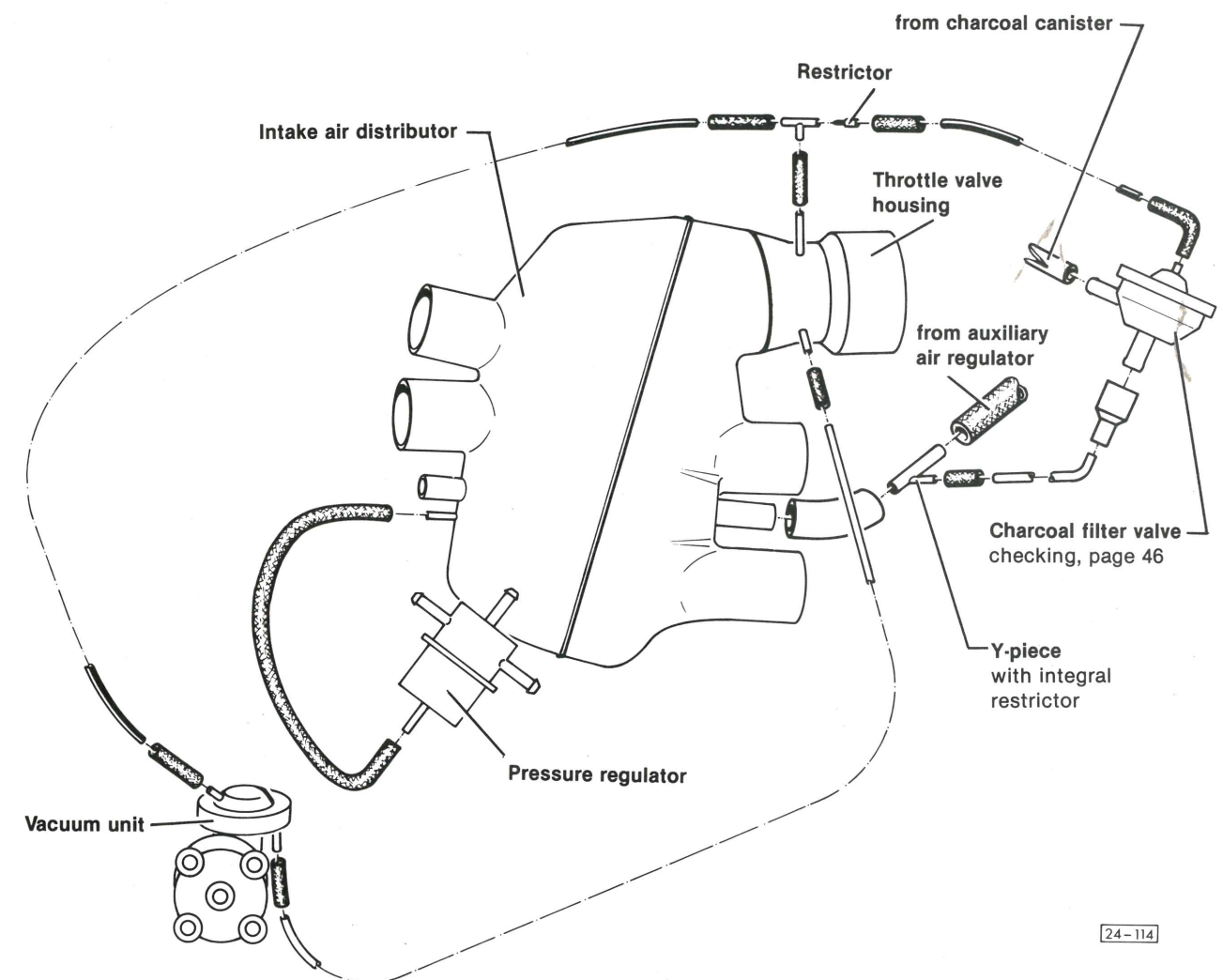
Notes

CAUTION
During repairs always replace gaskets, seals and clamps





24-112

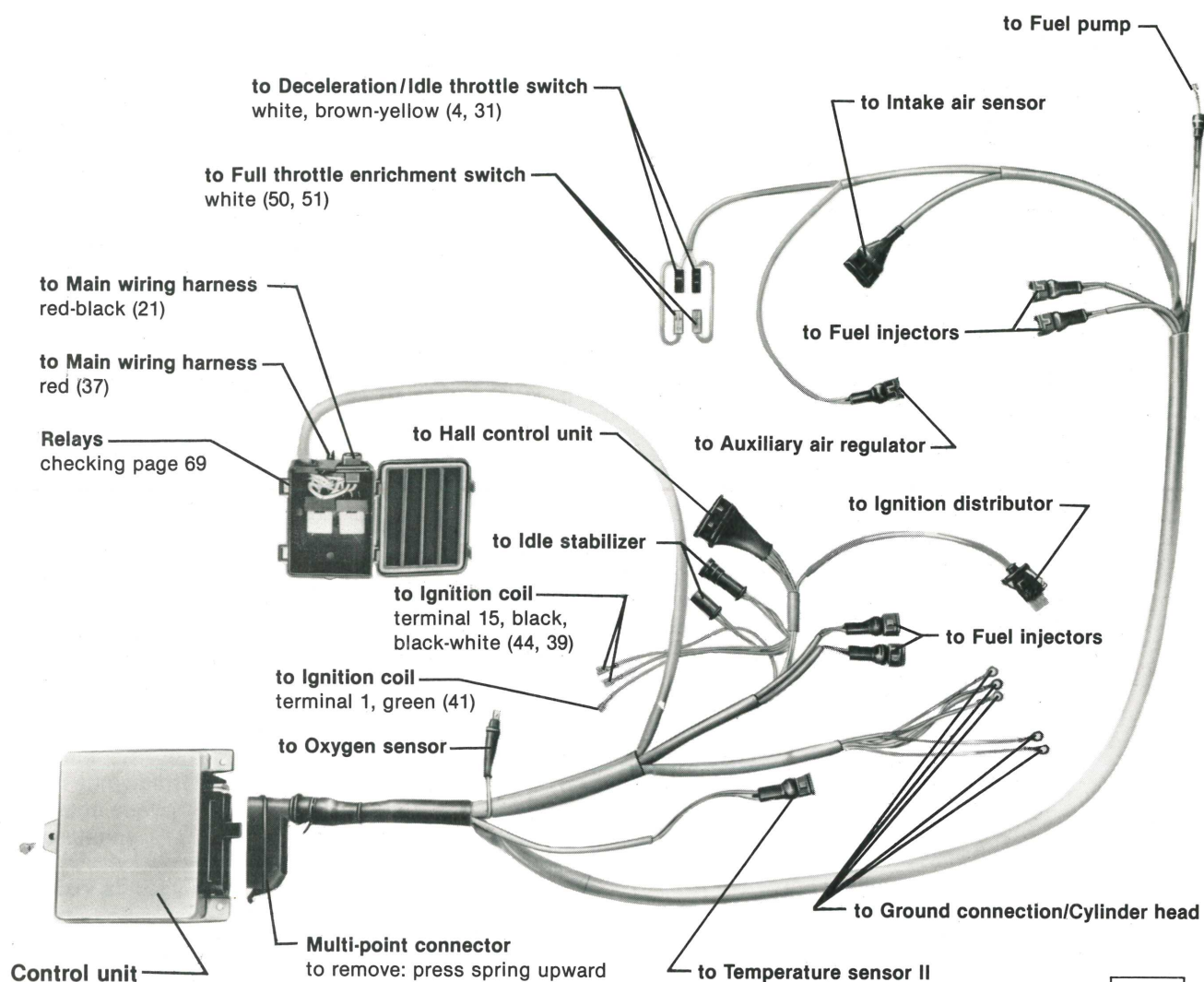


24-114

Technical data and specifications

Components—checking/adjusting	Specifications	Notes
Idle speed Idle stabilizer disconnected Idle stabilizer connected	850 ± 50 rpm 900 ± 50 rpm	• oxygen sensor connected
CO-value checking spec. adjusting spec.	0.3–1.1% 0.7 ± 0.4%	• oxygen sensor and idle stabilizer connected • oxygen sensor disconnected
Ignition timing	5° ± 1° ATDC	• idle stabilizer disconnected
Idle stabilizer control unit	below 940 rpm under load, ignition timing advances	• engage 4th gear at idle speed and engage clutch slowly; timing should advance
Fuel pump delivery rate	min. 500 cm³/30 sec.	• disconnect relay connection, turn ignition ON , let fuel pump run by using bridging adaptor US 4480/3
Pressure regulator/fuel pressure vacuum hose connected vacuum hose disconnected	approx. 2.0 bar (29 psi) approx. 2.5 bar (36 psi)	• idle speed • idle speed
Oxygen sensor wiring disconnected wiring connected	CO above 2% CO 0.3–1.1%	• vacuum hose at pressure regulator disconnected and plugged
Injectors fuel spray pattern voltage supply resistance	even, coneshaped spray test light flickering approx. 16–16.4 ohms	• operate starter • operate starter
Auxiliary air regulator cold warm	open closed	• pinch hose, rpm must drop • after idling about 5 min. pinch hose, rpm does not drop
Intake air sensor terminals: 6 and 9 7 and 9 6 and 22	approx. 560 ohms ohms—changing 2300–2700 ohms	— • move sensor plate • intake air sensor about 20 °C (68 °F)
Throttle valve switches for deceleration/idle speed for full throttle enrichment	closed only during idle speed closed at full throttle	— —

Components—checking/adjusting	Specifications	Notes
Temperature sensor I and II for intake air temperature and coolant temperature	<div>ohms ← Temperature Sensor → ohms</div> <div>Temperature of Temperature Sensor 24-116</div>	



It receives information on:

- air quantity from intake air sensor
- intake air temperature from temperature sensor I in intake air sensor
- engine temperature from temperature sensor II
- engine speed from ignition distributor
- oxygen in exhaust gas from oxygen sensor
- position of throttle valve from full throttle enrichment/deceleration switch and uses this information to determine amount of fuel to be injected

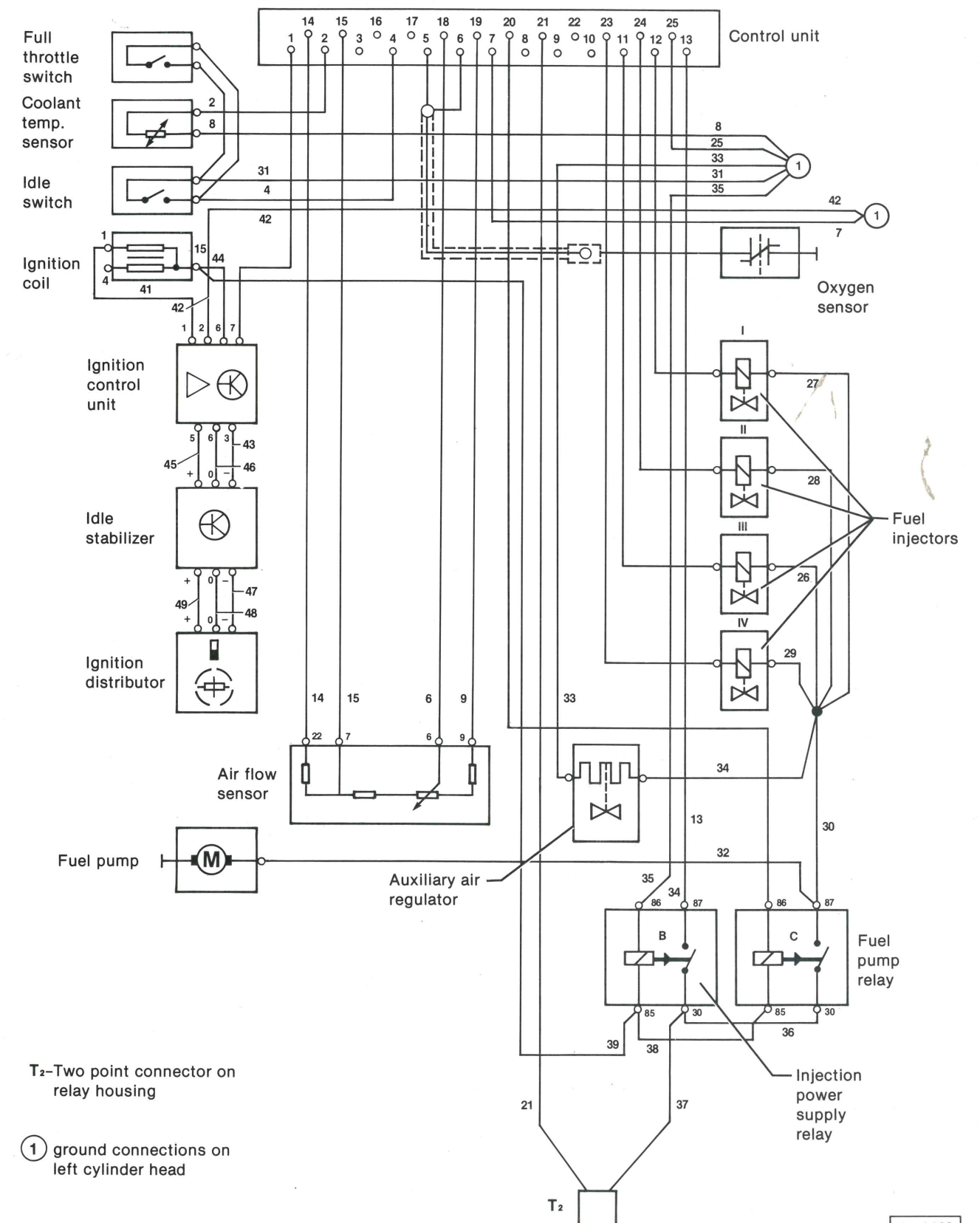
Note

Always replace control unit if defective, can not be repaired in workshop

Note

Wiring has white color, note stamped number on it

24-115



T₂—Two point connector on relay housing

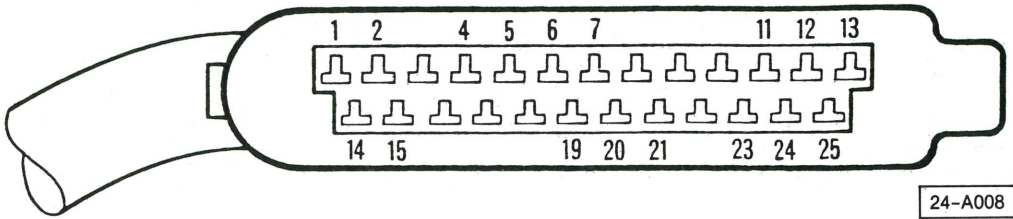
① ground connections on left cylinder head

24-A009

AFC System check with volt/ohmmeter

Note

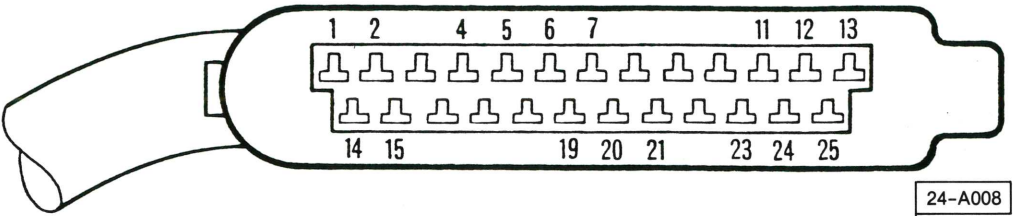
Entire AFC system can be checked electrically at disconnected multi-pin connector of control unit



— remove multi-pin connector and turn ignition ON

Tester to terminal:	Components	Checks	Specs
1 and 7	Hall control unit type: AEG	• voltage with ignition ON	battery voltage
1 and ignition coil terminal 15	HALL control unit type: FAIRCHILD	• touch center wire of connector at ignition distributor to ground	1.5 volt
2 and 7	Temperature sensor II (coolant temperature)	• resistance at 20 °C (68 °F) see diagram page 57	2300–2700 ohm
4*) and 7	Deceleration/idle switch Full throttle enrichment switch	• idle speed position • full throttle position	0 ohms 0 ohms
5 and 7	Oxygen sensor	• connector disconnected and grounded • connector connected	0 ohms ∞ ohms
6 and 19	Intake air sensor	• resistance/potentiometer	approx. 560 ohms
7 and 25	Ground connection/control unit	• wiring	0 ohms
11 and 7	Fuel injector, cyl. 4	• injector and wiring	approx. 16–16.4 ohms
12 and 7	Fuel injector, cyl. 3	• injector and wiring	approx. 16–16.4 ohms
13 and 7	Relay, left; terminal 87	• ignition ON; function of relay, left	battery voltage
14 and 6	Temperature sensor I (intake air temperature)	• resistance at 20 °C (68 °F)	2300–2700 ohms
15 and 19	Intake air sensor	• resistance/potentiometer; if sensor plate is moved	ohms—changing

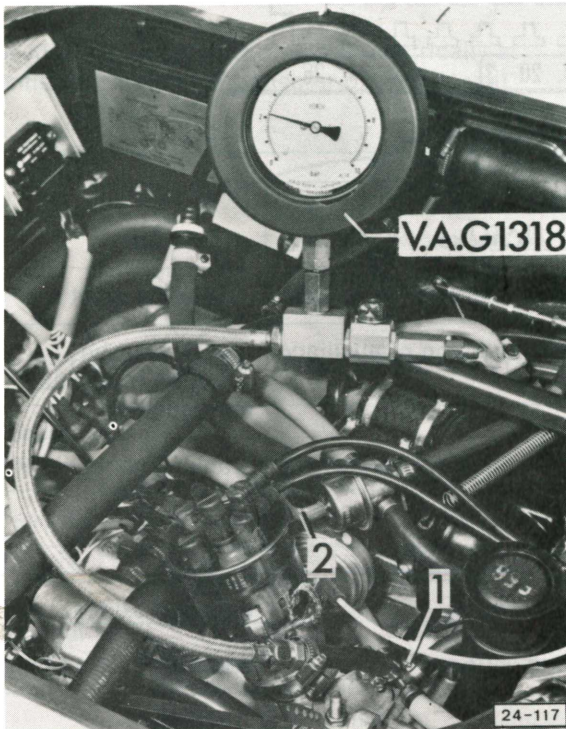
*) do not connect test light on this terminal if control unit is connected to multi-pin connector



Tester to terminal:	Components	Checks	Specs
20*) and 25 bridged	Relay, right; terminal 86*) Auxiliary air regulator	• ignition ON; function of relay, right • ignition ON; function of auxiliary air regulator	fuel pump must run power must be supplied to auxiliary air regulator
21 and 7	Wiring from starter; starting enrichment	• voltage at terminal 50 during starting — crank engine (with injector plugs OFF)	cranking voltage
23 and 7	Fuel injector, cyl. 1	• injector and wiring	approx. 16–16.4 ohms
24 and 7	Fuel injector, cyl. 2	• injector and wiring	approx. 16–16.4 ohms
25 and 7	Ground connection/control unit	• wiring	0 ohms

*) do not connect test light on this terminal if control is connected to multi-pin connector

Pressure regulator, checking



- connect pressure gauge V.A.G. 1318 or equivalent with adaptor to T-piece 1 of fuel line

CAUTION
Pressure gauge lever must be in closed position during measurement procedure

- run engine at idle speed and check pressure

Specifications:

bar (psi)	vacuum hose 2 (shown in above illustration)
approx. 2.0 (29)	connected
approx. 2.5 (36)	disconnected

Fuel injectors, checking

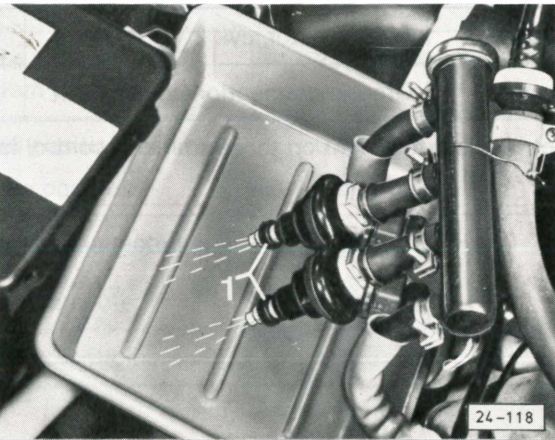
Work sequence

CAUTION
Do **not** disconnect terminal 1 at ignition coil when operating starter

Spray pattern

- pull out fuel injectors in pairs but leave electrical plugs and fuel lines connected
- disconnect electrical plugs at fuel injectors which are still installed (second pair)

WARNING
Fire hazard. Do not smoke or have anything in area that can ignite fuel



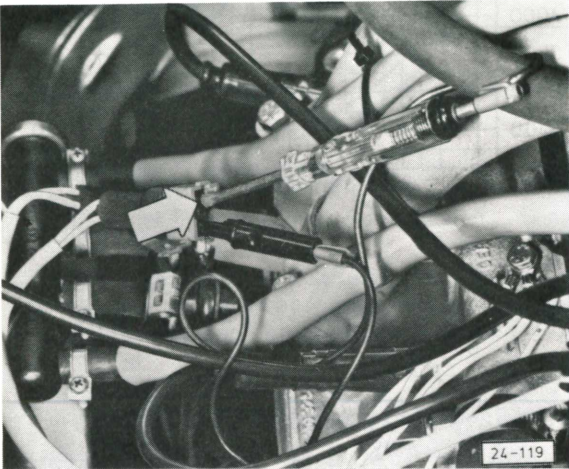
- hold injectors in jar or pan
- operate starter briefly
 - spray pattern must be an even, coneshaped spray
- reinstall fuel injectors with new sealing rings 1

Leak checking

- pull off electrical plugs at fuel injectors
- pull out injectors in pairs but leave connected to fuel ring line
- turn ignition **ON** for about 5 seconds (fuel pump operates briefly)
- check that no more than 2 drops leak from each injector in one minute

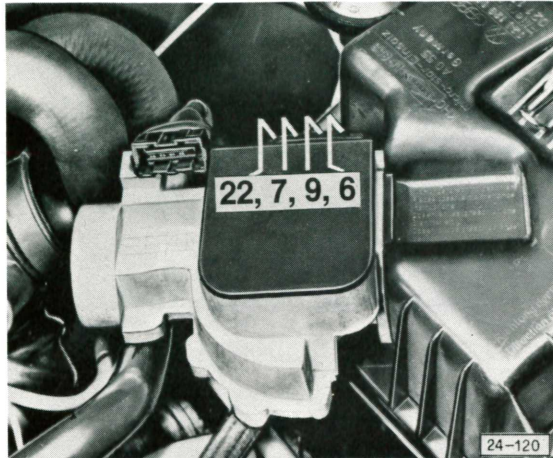
Voltage supply

CAUTION
To prevent damage to control unit, **do not** short-circuit connector contacts



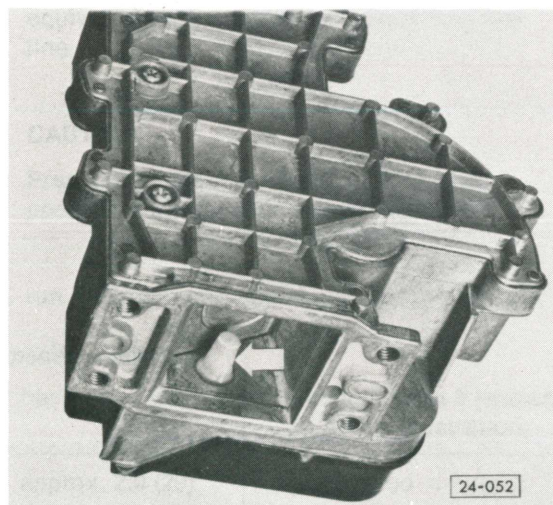
- pull off all electrical plugs from fuel injectors
 - connect test light to one plug contact (arrow)
 - operate starter
 - test light must flicker
- if **NO**
- check relays, see page 65
 - check impulse output of Hall control unit terminal 7
 - check all ground connections at cylinder head

Intake air sensor, checking

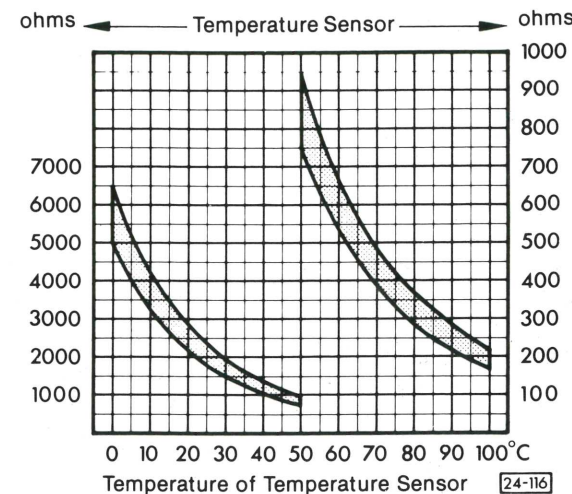


- pull off hose and electrical connector from intake air sensor
- connect ohmmeter to following terminals of potentiometer (arrows)
 - 6 and 9: approx. 560 ohms
 - 7 and 9: when moving sensor plate = ohms changing

Temperature sensor I, checking



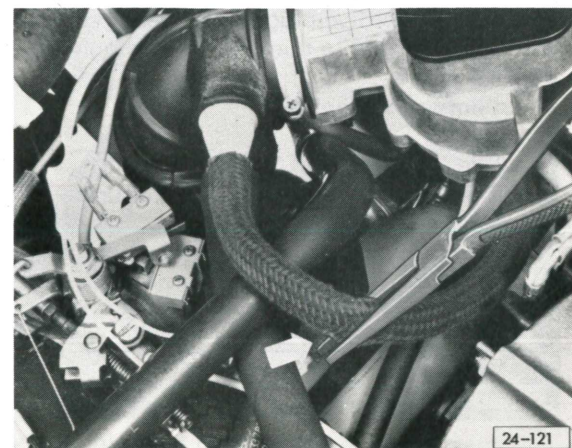
- connect ohmmeter to terminals 6 and 22
- ohmmeter reading should correspond to graph



Note

If specifications are not reached, replace intake air sensor and readjust idle speed/CO value (see page 68)

Auxiliary air regulator, checking



Note

When engine is cold, regulator is open fully, allowing additional air to engine

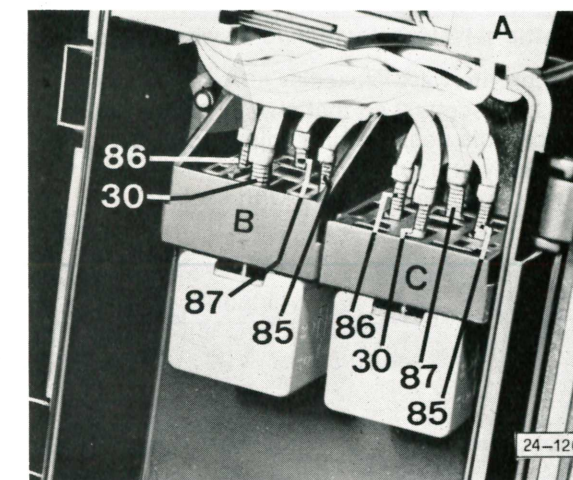
- engine cold
- run engine at idle speed
- pinch hose (arrow)
 - rpm must drop
- run engine at idle speed for about 5 minutes more
- repeat above test
 - rpm must not change
- if **NO**
 - disconnect electrical plug from auxiliary air regulator
 - check voltage supply with engine running
- if **OK**
 - replace auxiliary air regulator

Relays, checking (with relays installed)

CAUTION

Do not connect any test light to terminal 86 of adaptor C (shown in illustration) if control unit is connected

- remove all electrical plugs at fuel injectors



- turn ignition **ON**
- connect test light to ground and check following terminals for voltage:
 - connection **A** = red wire terminal 30
 - adaptor **B** = terminals 30, 85, 87
 - adaptor **C** = terminals 30 and 85
 - test light should light
- operate starter and check with test light
 - adaptor **C** = terminal 87
 - test light should light
 - if test light does not light, check wiring by using current flow diagram (see page 59)
 - if wiring is OK and no voltage at terminal 87, check relay
 - if relay is OK, replace control unit

Relay on adaptor B, checking

- turn ignition **ON**
- connect test light to terminals 30 and 86
 - test light must light up
- if **NO**, check wiring with current flow diagram, see page 59
- connect test light to terminals 86 and 87
 - test light must light up
- if **NO**, replace relay on adaptor B

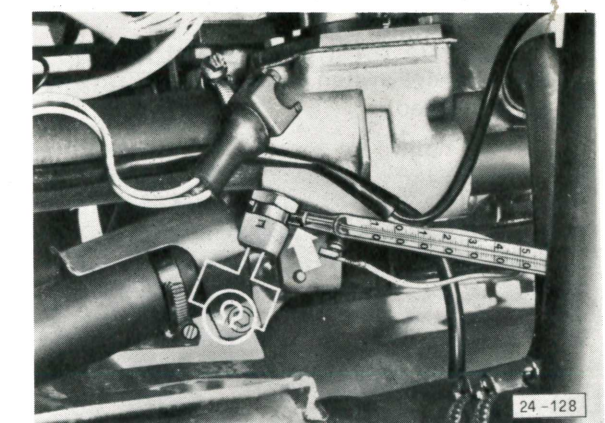
Relay on adaptor C, checking

- connect test light between terminals 30 and 86
- crank engine
 - test light must light
- if **NO**, check wire to terminal 20 of control unit
- if **OK**, replace control unit
- connect test light to terminal 87
- crank engine
 - test light must light
- if **NO**, replace relay on adapter C

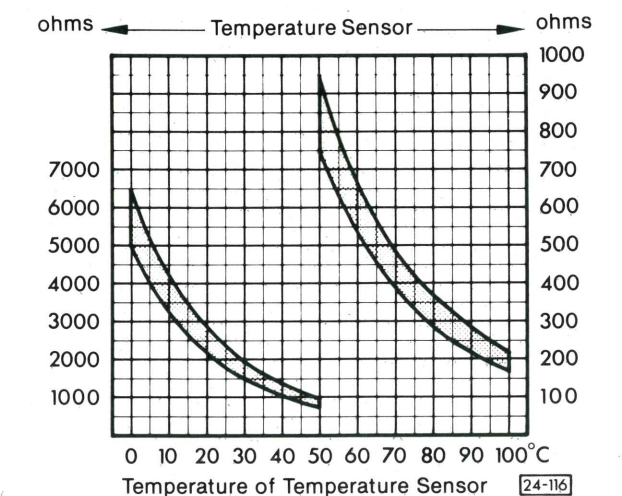
Temperature sensor II, checking

Note

Temperature sensor II in coolant thermostat housing supplies control unit with information for starting and warm-up enrichment



- check temperature and resistance of temperature sensor II
- check specifications, see diagram below:



Throttle valve/deceleration/idle switch, checking

Note

This switch supplies control unit with information that throttle valve is **closed**.

If engine is above 1500 rpm with the throttle closed, fuel will be shut off to the injectors.

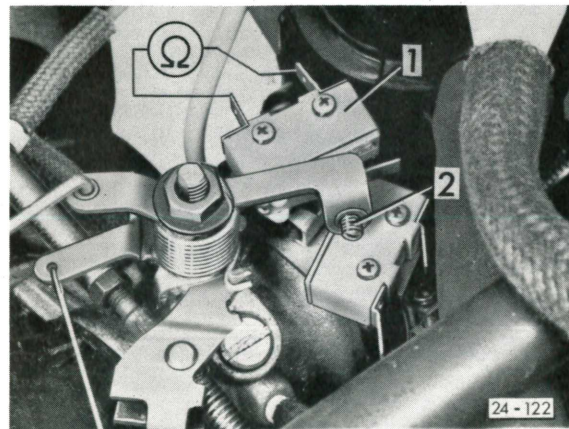
At idle speed, this switch signals control unit to regulate amount of fuel injected

CAUTION

Do **not** connect test light to throttle valve switch connectors if control unit is connected

First check (Throttle valve switch)

- throttle valve switch connectors disconnected



- attach ohmmeter to switch 1
 - throttle valve closed
switch turned **ON** = 0 ohm
 - throttle valve open
switch turned **OFF** = ∞ ohm

Second check (Wiring and control unit)

- run engine at idle speed for a short time
 - stop engine and turn ignition **ON**
 - pull off connectors from both throttle valve switches
 - check voltage between connectors of throttle valve idle switch
 - voltage should be approx. 5 volt
- if **NO**, control unit is defective or break in wiring

Third check (Deceleration)

Test condition

- result of first and second check must be OK
- throttle valve switch connectors connected
- temperature at temperature sensor II must be minimum 60°C (140°F) and resistance below 550 ohms
- operate throttle valve switch by hand and accelerate slowly
 - engine speed must fluctuate (surges)

If **NO**, replace control unit

Throttle valve/deceleration/idle switch, adjusting

- throttle valve closed
- adjust screw 2 so that switch just closes
- from this position turn adjusting screw exactly one turn farther in
- secure adjusting screw with sealant

Note

Correct adjustment is very important
If switch is mis-adjusted engine may surge or cut-out during acceleration

Full throttle enrichment switch, checking

Note

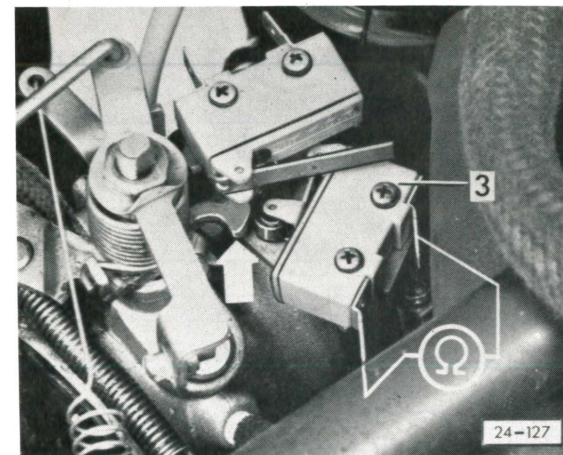
Full throttle enrichment switch supplies the control unit with information to increase amount of fuel injected at full throttle

CAUTION

Do **not** test light to throttle valve switch connectors if control unit is connected

First check (Throttle valve switch)

- throttle valve switch connectors disconnected



- attach ohmmeter to switch 3
 - throttle valve closed
switch turned **OFF** = ∞ ohms
 - throttle valve full open
switch turned **ON** = 0 ohms

Second check (Wiring and control unit)

- run engine at idle for a short time
 - stop engine and turn ignition **ON**
 - pull off connectors from both throttle valve switches
 - check voltage between connectors of full throttle enrichment switch
 - voltage should be approx. 5 volts
- if **NO**, control unit is defective or break in wiring

Third check (Full throttle enrichment)

Test conditions:

- result of first and second check must be OK
 - throttle valve switch connectors connected
 - temperature at temperature sensor II must be minimum 60°C (140°F) and resistance below 550 ohms
 - CO tester and tachometer connected
 - run engine for about 2 minutes at idle speed
 - increase idle speed slowly until tachometer reads about 4000 rpm
 - CO should be between 0.3 to 1.1%
 - with engine at about 4000 rpm, operate full throttle enrichment switch 3 by hand for about 15 seconds
 - CO must increase above 1.5%
- if **NO**, control unit is defective

Full throttle enrichment switch, adjusting

- loosen retaining screw for switch
- open throttle valve fully and move switch until cut-in position is reached
 - position of roller should be nearly in center of cam disk (arrow, photo, 24-127)
- retighten retaining screw for switch

Idle speed/CO, checking/adjusting

CAUTION

It is important to follow work sequence when checking and adjusting idle speed and CO value

1. Check ignition timing; if necessary adjust
 - idle stabilizer bypassed
 - oxygen sensor connected
2. Check idle speed; if necessary adjust
 - idle stabilizer bypassed
 - oxygen sensor connected
3. Check CO value; if necessary adjust
 - idle stabilizer connected
 - disconnect oxygen sensor wiring connection with ignition **OFF**

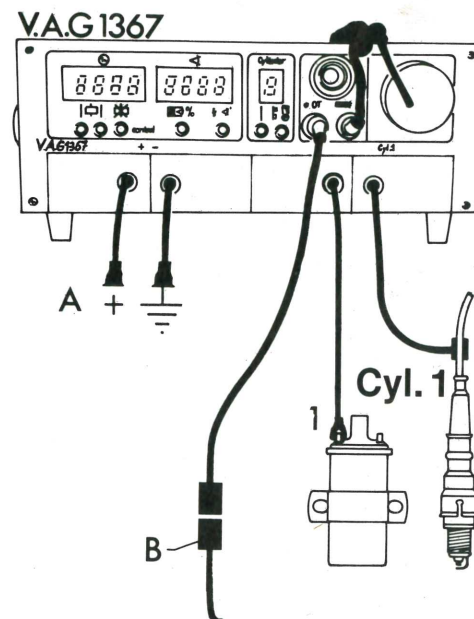
Work sequence

Preliminary conditions:

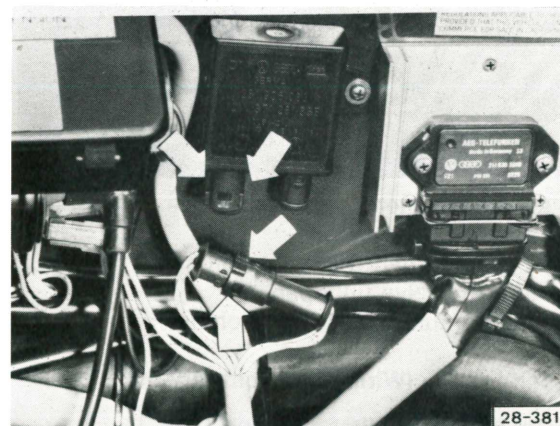
- engine oil temperature min. 60°C (140°F)
- all electrical equipment must be turned **OFF** (radiator fan must not run)

CAUTION

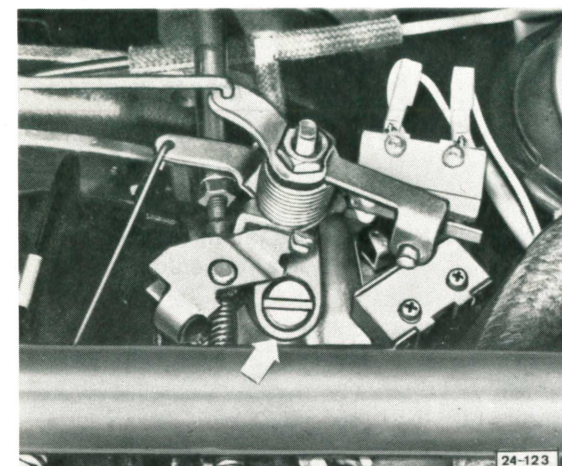
Ignition must be switched **OFF** before connecting tester



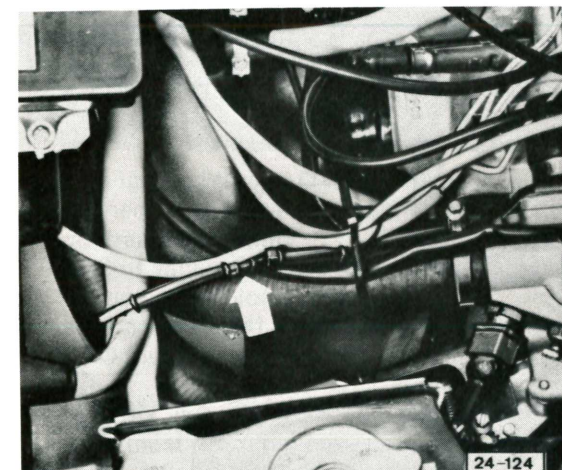
- connect tester V.A.G. 1367 as follows
 - **A** to alternator or terminal box
 - **B** to TDC sender
- connect CO meter to receptacle in left exhaust pipe



- check ignition timing and adjust if necessary
- disconnect electrical plugs at idle stabilizer control unit (squeeze to release—arrows)
- connect plugs together
- start engine and check ignition timing and adjust if necessary
 - spec. = $5 \pm 1^\circ$ ATDC
 - rpm = below 1000
- adjust ignition timing, see Repair Group 28



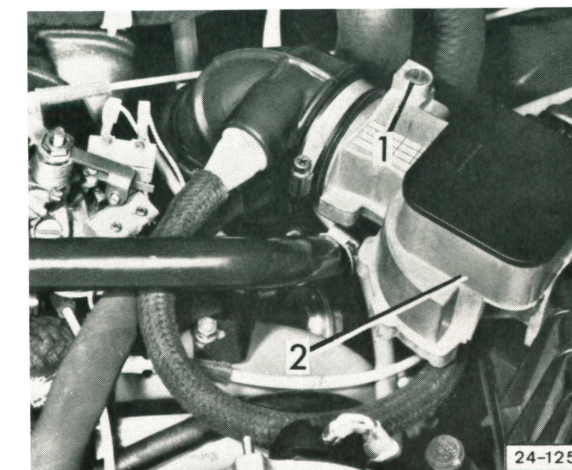
- run engine at idle speed
- check RPM after 2 minutes, if necessary adjust with screw (arrow)
- stop engine



- check CO and adjust if necessary
 - idle stabilizer connected
- with engine **OFF** disconnect electrical connection at oxygen sensor (arrow)
- start engine and check CO value
 - checking spec. = 0.3–1.1%

Note

- If CO value is above 1.1% pinch crankcase hose.
- CO should drop below 1.1%
- if **YES**, CO adjustment is not necessary (engine oil dilution—change engine oil)
- if **NO**, adjust CO (continue with procedure)
- stop engine



- adjust CO as follows:
- remove intake air sensor 2
- center-punch plug in CO adjusting hole
- drill 2.5 mm (3/32 in.) hole in center of plug 3.5–4.0 mm (9/64–5/32 in.) deep

CAUTION

Clean up any metal shavings

- screw in 3 mm (1/8 in.) sheet-metal screw
- remove plug with screw, using pliers
- reinstall intake air sensor 2
- start engine (oxygen sensor disconnected)
- adjust CO to $0.7 \pm 0.4\%$
- stop engine
- drive in new plug flush with intake air sensor
- reconnect electrical connection of oxygen sensor

Note

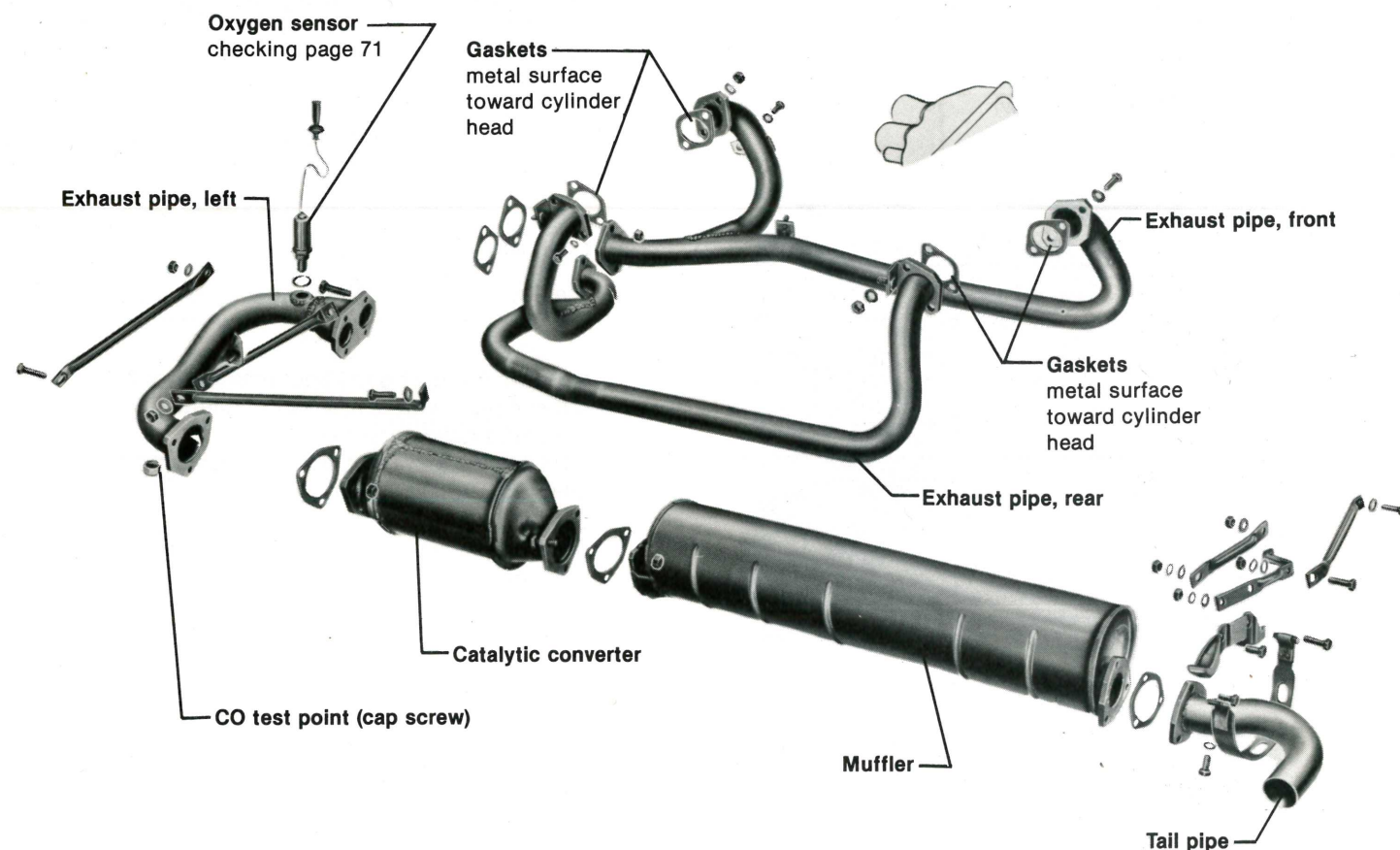
- With oxygen sensor and idle stabilizer connected
 - CO must be: 0.3–1.1%
 - Idle speed: 850–950 rpm

Idle stabilizer control unit checking, see Repair Group 28

Oxygen sensor checking, see Repair Group 26

Note

Always replace gaskets, seals and self-locking nuts. Tighten all M8 bolts to 20 Nm (14 ft lb)



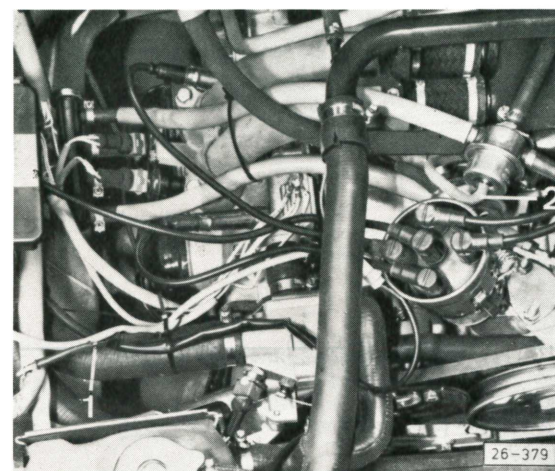
Oxygen sensor, checking

Preliminary condition:

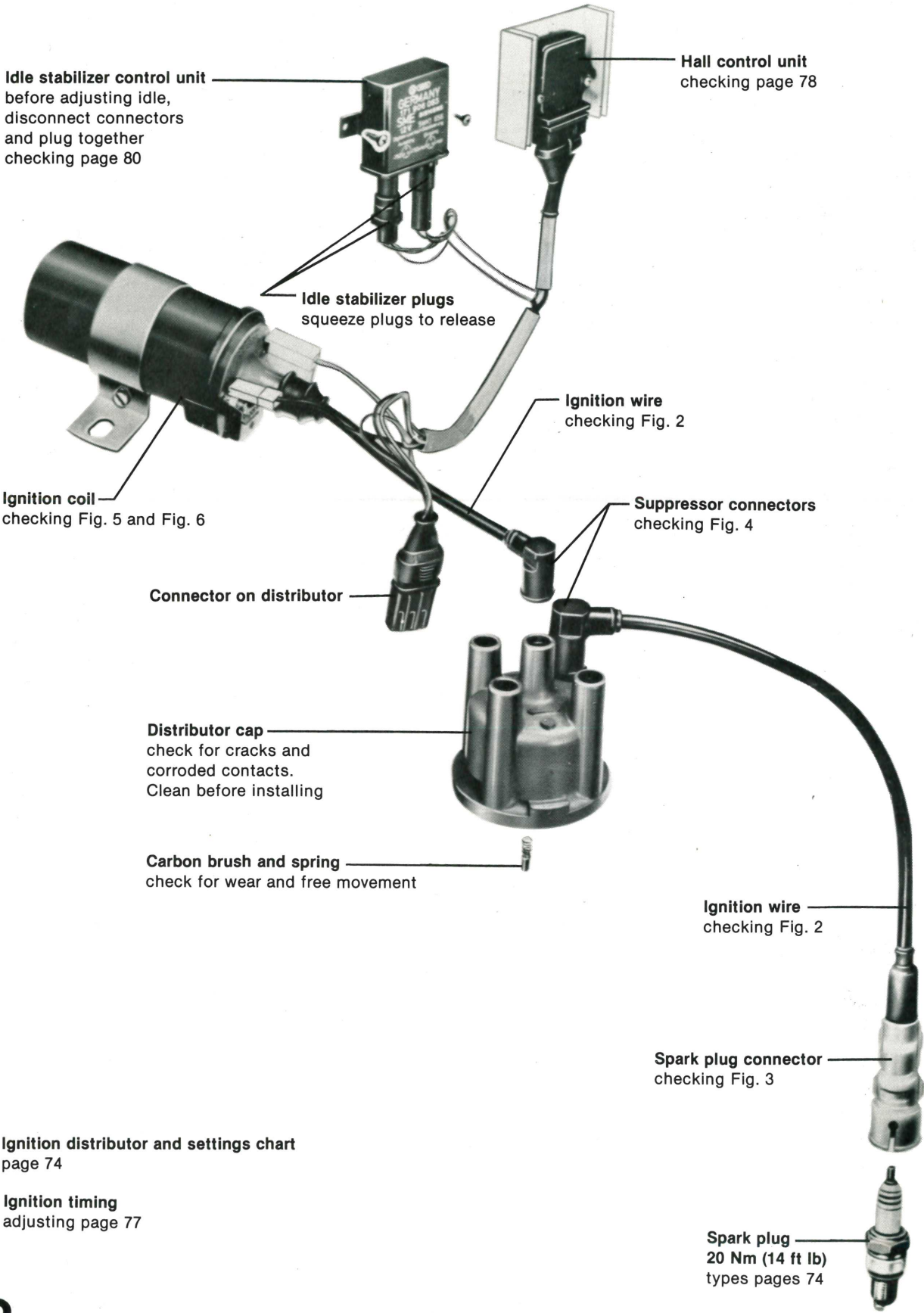
- engine oil temperature at least 60 °C (140 °F)

Work sequence

- connect CO meter to test receptacle on exhaust pipe (left side)

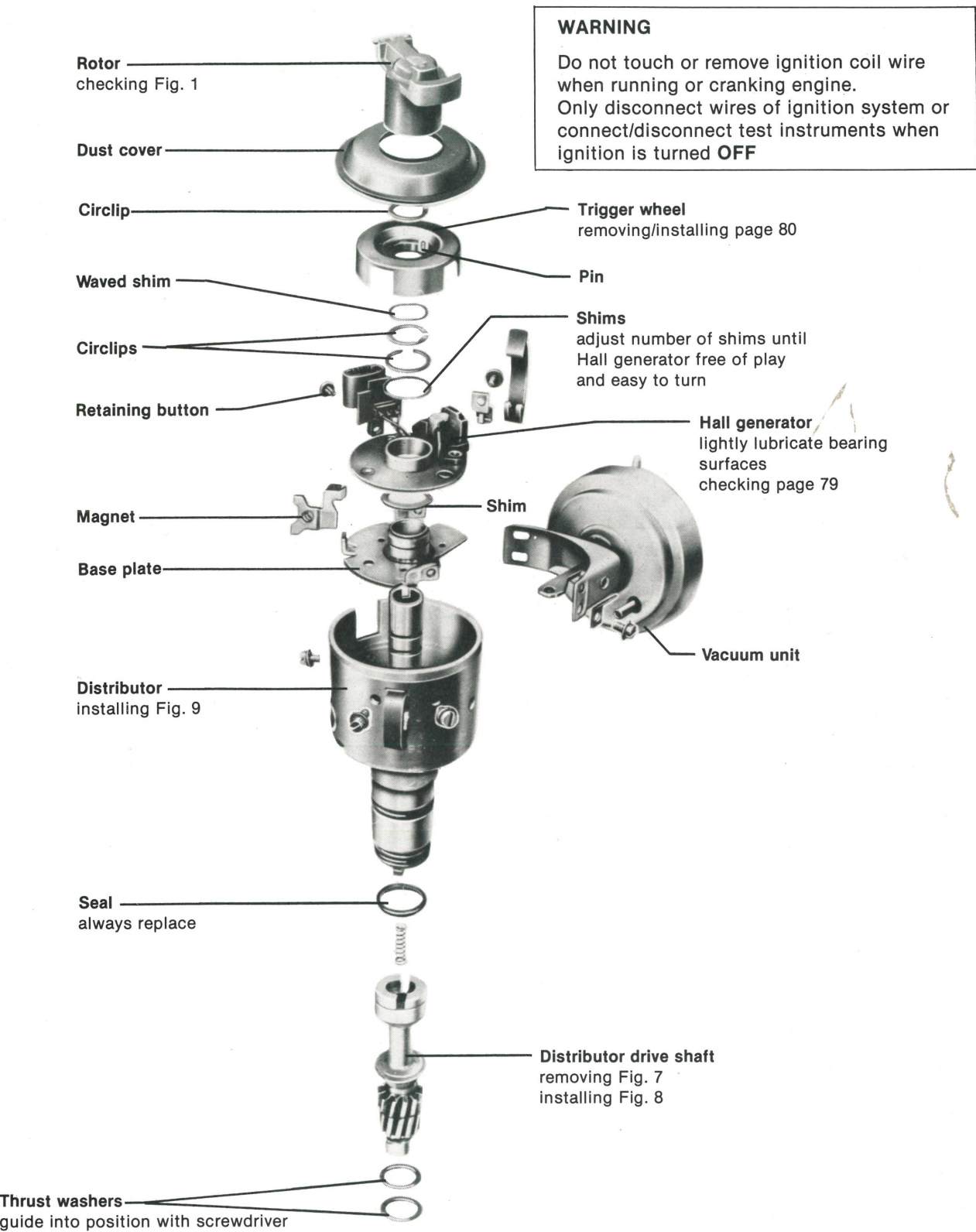


- with ignition turned **OFF**, disconnect connection 1 between oxygen sensor and control unit
- pull off vacuum hose 2 from pressure regulator and block hose
- start engine
 - CO must increase to above 1.5%
- after about 2 minutes reconnect connection 1
 - CO must drop to $0.7 \pm 0.4\%$
- if NO**, following components may be defective:
 - wire between oxygen sensor and control unit or control unit
- check wiring by disconnecting connection 1 again and ground wire end coming from control unit
 - CO must increase
- if OK**, oxygen sensor must be defective or leak in exhaust system between catalytic converter and cylinder head

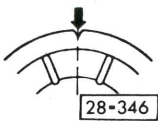


Ignition distributor and settings chart
page 74

Ignition timing
adjusting page 77



28-371

Engine code letters	DH
Distributor (Part No.)	025 905 205 D
Ignition timing	5 ± 1° ATDC
Timing mark location: crankshaft pulley	
Idle speed	850 ± 50 rpm
Vacuum hoses connected	
Idle stabilizer control unit	electrical plugs disconnected from unit and connected together
Centrifugal advance (crankshaft degrees)	
start	1050-1150 rpm
	16-20° at 2400 rpm
end	21-25° at 3800 rpm
Vacuum advance	
start	190-230 mbar (14.0-17.0 cm Hg)
end	360 mbar (27.0 cm Hg) 12-16°
Vacuum retard	
start	100-220 mbar (7.5-16.5 cm Hg)
end	260-360 mbar (19.5-27.0 cm Hg) 9-11°
Spark plugs	Bosch Beru Champion
	W 7 C 0 14 L-7 C N 288
Spark plug gap	0.7 + 0.1 mm (0.028 + 0.004 in.)
Spark plug tightening torque	20 Nm (14 ft lb)
Firing order	1-4-3-2

CAUTION

- When working on **vehicles with transistorized ignition system**, observe following precautions to prevent injury or damage to ignition system
- do not touch or remove coil wire when running or cranking engine
 - only disconnect wires of ignition system when ignition is switched off
 - only connect/disconnect test instrument when ignition is switched off
 - do not connect any condenser/suppressor to terminal 1 or 15
 - do not tow cars (with ignition on) without disconnecting plugs on ignition control unit
 - do not crank engine before coil wire of distributor cap (terminal 4) is connected to ground with jumper wire (example: compression check etc.)
 - do not replace installed coil with conventional type
 - do not leave battery connected when electric welding on car
 - do not substitute ignition distributor rotor (marked R1) with one of different type
 - when installing suppressors, use 1000 ohm for coil wire terminal 4 and spark plug wires. Use 1000-5000 ohm spark plug connectors
 - do not wash engine when it is running
 - do not use battery booster longer than 1 minute nor exceed 16.5 volts with booster

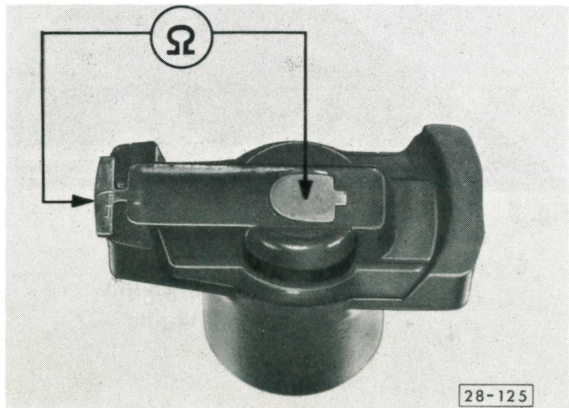


Fig. 1 Rotor, checking

- check that resistance is 1000 ± 400 ohms

Note

Rotor must be marked with R 1 for Hall generator equipped cars

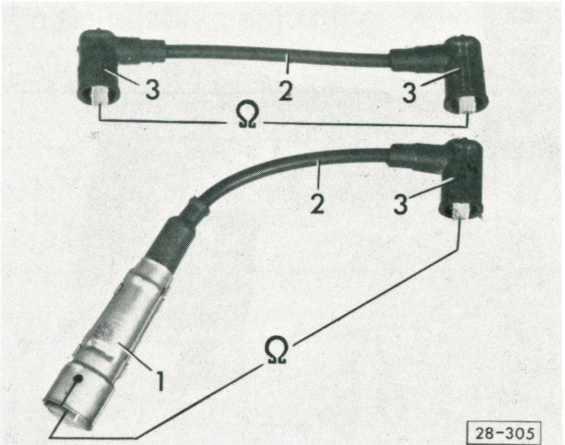


Fig. 2 Ignition wires and connectors, checking

- check wire 2 between ignition coil and distributor (including connectors 3)
 - resistance should be = 2000 ± 800 ohms
- check wires 2 between distributor and spark plugs (including connectors 3 and 1)
 - resistance should be = 6000 ± 1400 ohms
- if values are not as specified, check wires and connectors individually
 - resistance of wires (without connectors) must be = 0 ohm

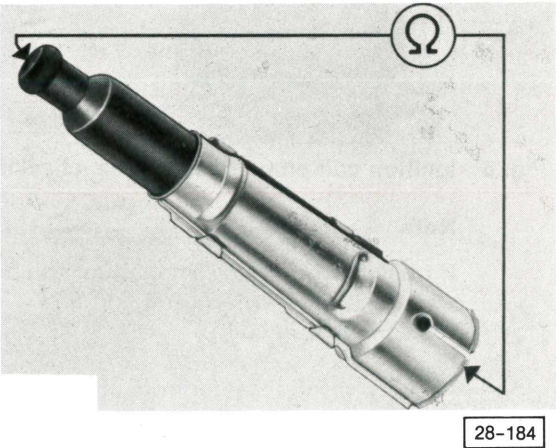


Fig. 3 Spark plug connectors, checking

- check connectors resistance
 - specified value = 5000 ± 1000 ohms

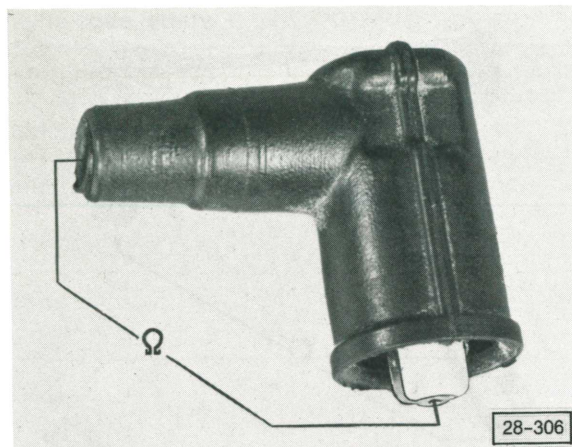


Fig. 4 Suppressor connectors, checking

- check resistance of suppressor connectors
- specified value = 1000 ± 400 ohms

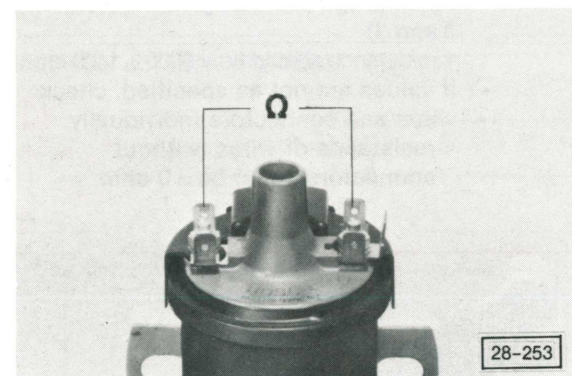


Fig. 5 Ignition coil primary resistance, checking

Note

If traces of leakage from ignition coil are visible check HALL control unit and replace ignition coil

- disconnect all wires from coil terminals
- connect ohmmeter between terminal 1 (–) and terminal 15 (+)
- resistance should be = $0.520\text{--}0.760$ ohms
- check secondary resistance (Fig. 6)

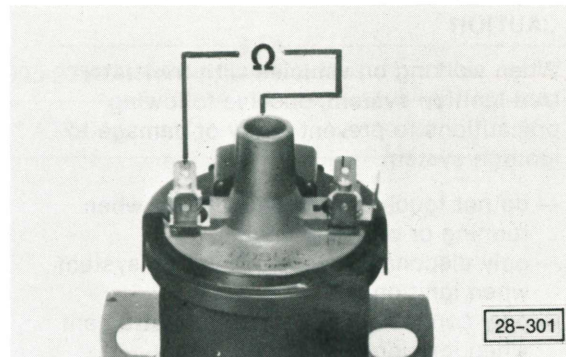


Fig. 6 Ignition coil secondary resistance, checking

- connect ohmmeter between terminal 1 (–) and terminal 4
- resistance should be = $2400\text{--}3500$ ohms

if **NO**, replace ignition coil

Note

If resistance readings are correct, but no high voltage occurs at ignition coil, check Hall generator and Hall control unit. If necessary, replace ignition coil

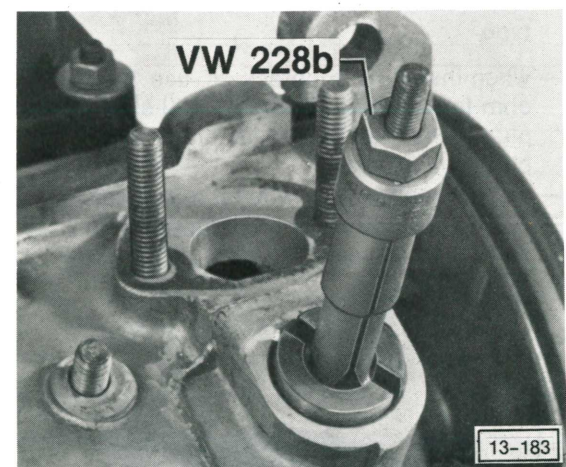


Fig. 7 Distributor drive shaft, removing

- use extractor with diameter $14.8\text{--}18.5$ mm ($0.583\text{--}0.728$ in.)

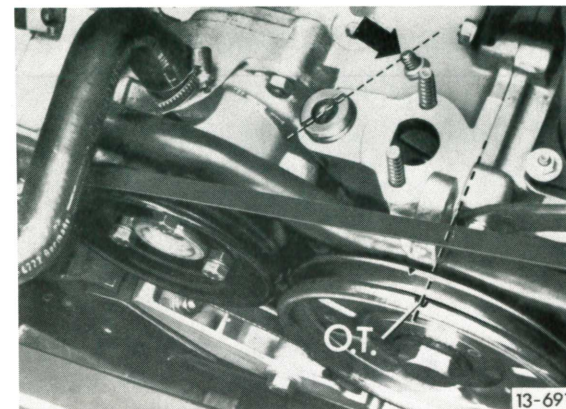


Fig. 8 Distributor drive shaft, installing

- set crankshaft to TDC on No. 1 cylinder
- insert drive shaft so that off-set slot in top of drive shaft is pointing toward bolt (arrow)
- smaller segment points to water pump

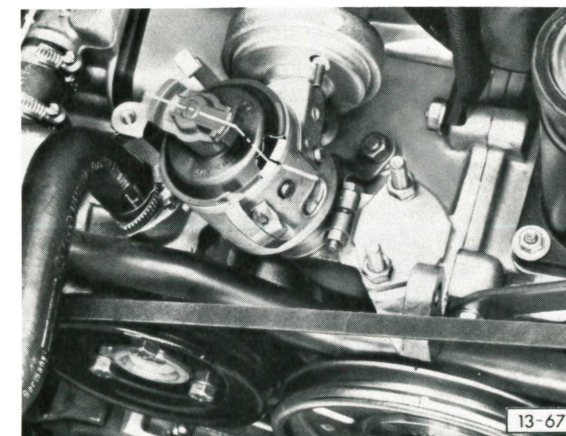


Fig. 9 Distributor, installing

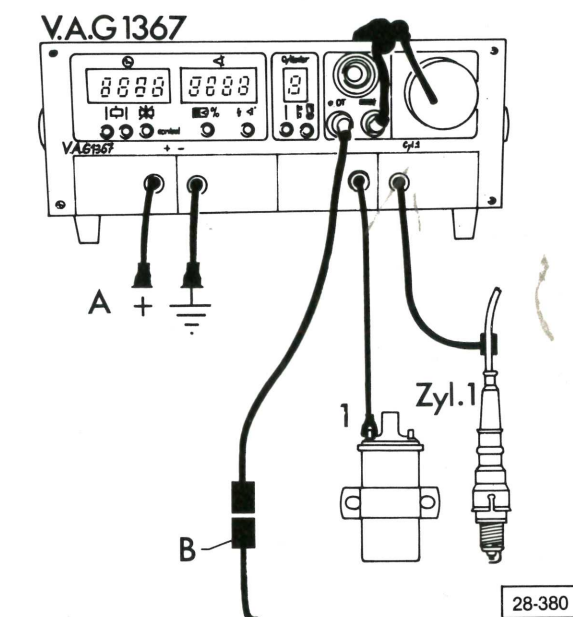
- set crankshaft to TDC on cylinder No. 1
- turn rotor until it is pointing to No. 1 cylinder mark on edge of housing
- install distributor
- clean distributor cap, check for cracks, signs of tracking and rotor tightness on shaft
- adjust ignition timing

Ignition timing, adjusting

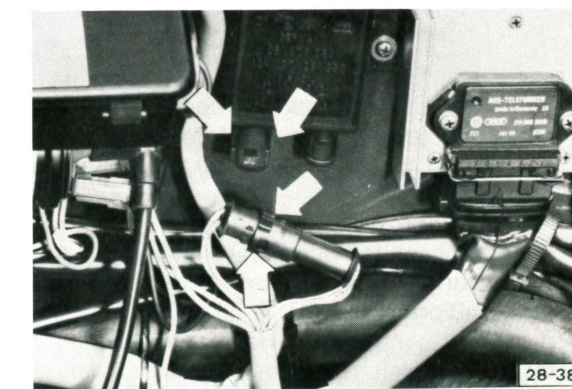
Work sequence

CAUTION

Ignition must be switched OFF before connecting tester



- connect tester according to manufacturer's instructions
- connect + (plus) cable to alternator or junction box



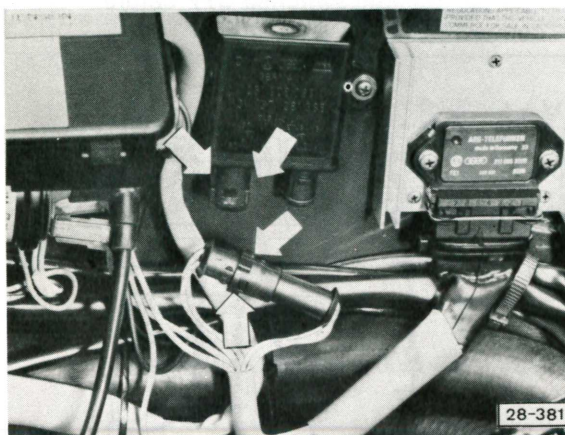
- disconnect idle stabilizer plugs from control unit (squeeze plugs to release—upper arrows)
- connect plugs together (lower arrows)
- adjust idle speed to 850 ± 50 rpm
- check ignition timing and adjust if necessary
- 5° ATDC

Hall control unit, checking

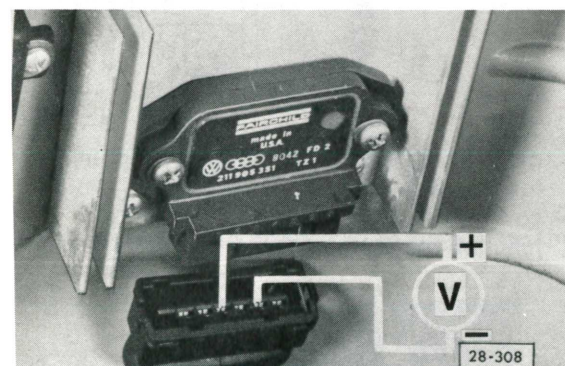
Work sequence

Test condition:

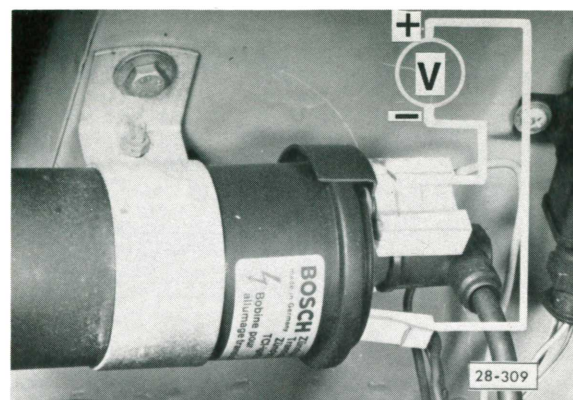
- ignition coil OK



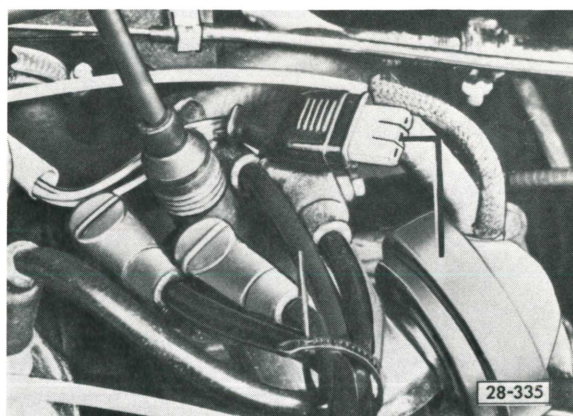
- disconnect idle stabilizer plugs from control unit (squeeze plugs to release—upper arrows)
- connect plugs together (lower arrows)



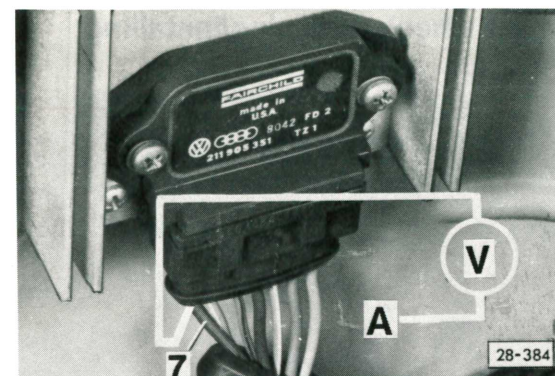
- remove connector from Hall control unit
- connect voltmeter with + (plus) to terminal 4 and with - (minus) to terminal 2 in connector
- turn ignition ON
 - spec = approx. battery voltage
 - if not, check for wire breaks and repair (see current flow diagram)
- turn ignition OFF
- reconnect connector to Hall control unit
- disconnect Hall generator connector from ignition distributor



- connect voltmeter with + (plus) to terminal 15 and with - (minus) to terminal 1 of ignition coil
- turn ignition ON
 - spec. = 2 volts (min.) for about 1-2 seconds and then drops to 0 volts
 - if not, replace Hall control unit and ignition coil



- touch center wire of connector on distributor briefly to ground
 - indicated voltage must increase briefly to 2 volts (minimum)
 - if not, check for wire break in center wire and repair or replace Hall control unit if wire is OK
- turn ignition OFF
- go to next page



Note

Two different types of Hall control units can be installed

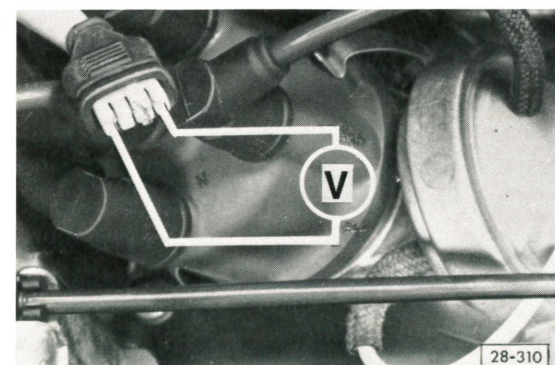
- connect Voltmeter as follows:

FAIRCHILD—Hall control unit

- connection A to terminal 15 (+) of ignition coil and other connection to terminal 7

AEG—Hall control unit

- connection A to ground and other connection to terminal 7
 - voltmeter must show approximately battery voltage
- touch center wire of connector on distributor briefly to ground (see illustr. 28-335)
 - indicated voltage must drop briefly below 1.5 V



- connect voltmeter to outer terminals of Hall generator connector
- turn ignition ON
 - spec. = 5 volts (min.)

Note

If readings are within specifications, but defect still exists, replace Hall control unit or check for wire breaks between Hall generator connector and Hall control unit; if necessary, repair

Hall generator, checking

Test conditions:

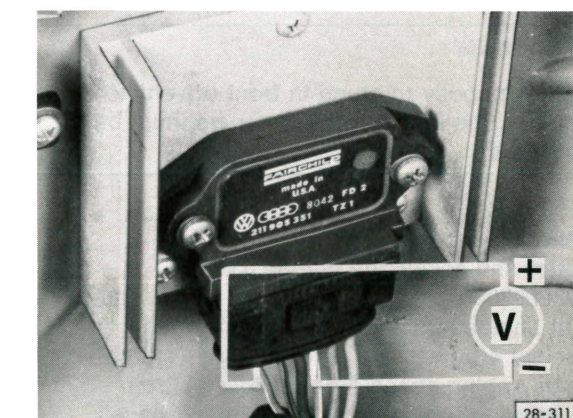
- disconnect both wire plugs from idle stabilizer and connect them together
- Hall control unit OK
- ignition coil OK
- wiring between Hall control unit and ignition coil OK
- connector pins and sockets on Hall-generator, distributor, and Hall control unit OK

Specified values given are valid for ambient temperatures from 0 to 40°C (32 to 104°F)

CAUTION

Set tester to read voltage before connecting test leads

- disconnect center coil wire from terminal 4 of distributor and connect to ground, using jumper wire



- pull rubber boot from control unit connector (with connector connected) as shown
- connect + (plus) wire of voltmeter to terminal 6 and - (minus) wire to terminal 3
- turn ignition ON

- turn engine over slowly by hand (in running direction) and watch tester reading
 - spec. = voltage must fluctuate between 0 and minimum 2 volts

If NO, replace Hall generator

Idle stabilizer, checking

Work sequence

Note

If engine is difficult to start, does not start, or engine misfires/stalls, proceed as follows:

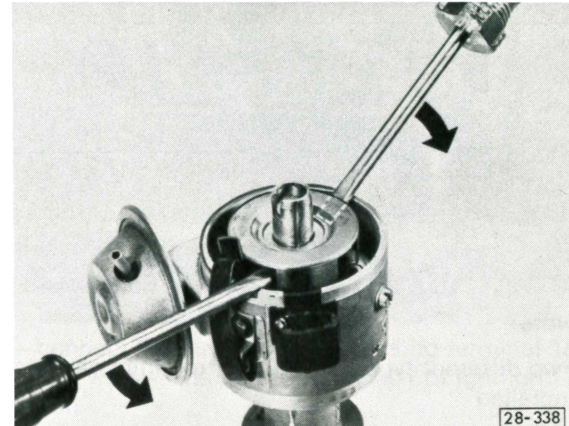
- disconnect both wire plugs from idle stabilizer
- check contact pins and sockets of both idle stabilizer connectors for correct position or damage
- connect both plugs together
- start engine
 - if starting troubles are still experienced, idle stabilizer control unit is **not** defective
 - if engine starting troubles are eliminated, but troubles start again after reconnecting plugs to idle stabilizer unit, idle stabilizer unit must be defective; replace
- connect V.A.G. 1367 tester or equivalent according to manufacturer's instructions
- apply parking brake

WARNING

Allow nobody to stand in front of vehicle during this test. Vehicle's wheels must be blocked

- apply foot brake
- start and accelerate engine (i.e. to 2500–3000 rpm) briefly
- let engine idle and note ignition timing
- select 4th gear and slowly engage clutch
 - as engine speed drops **below 940 rpm** ignition timing must move in "advance" direction
- if not, replace idle stabilizer control unit

Trigger wheel, removing/installing

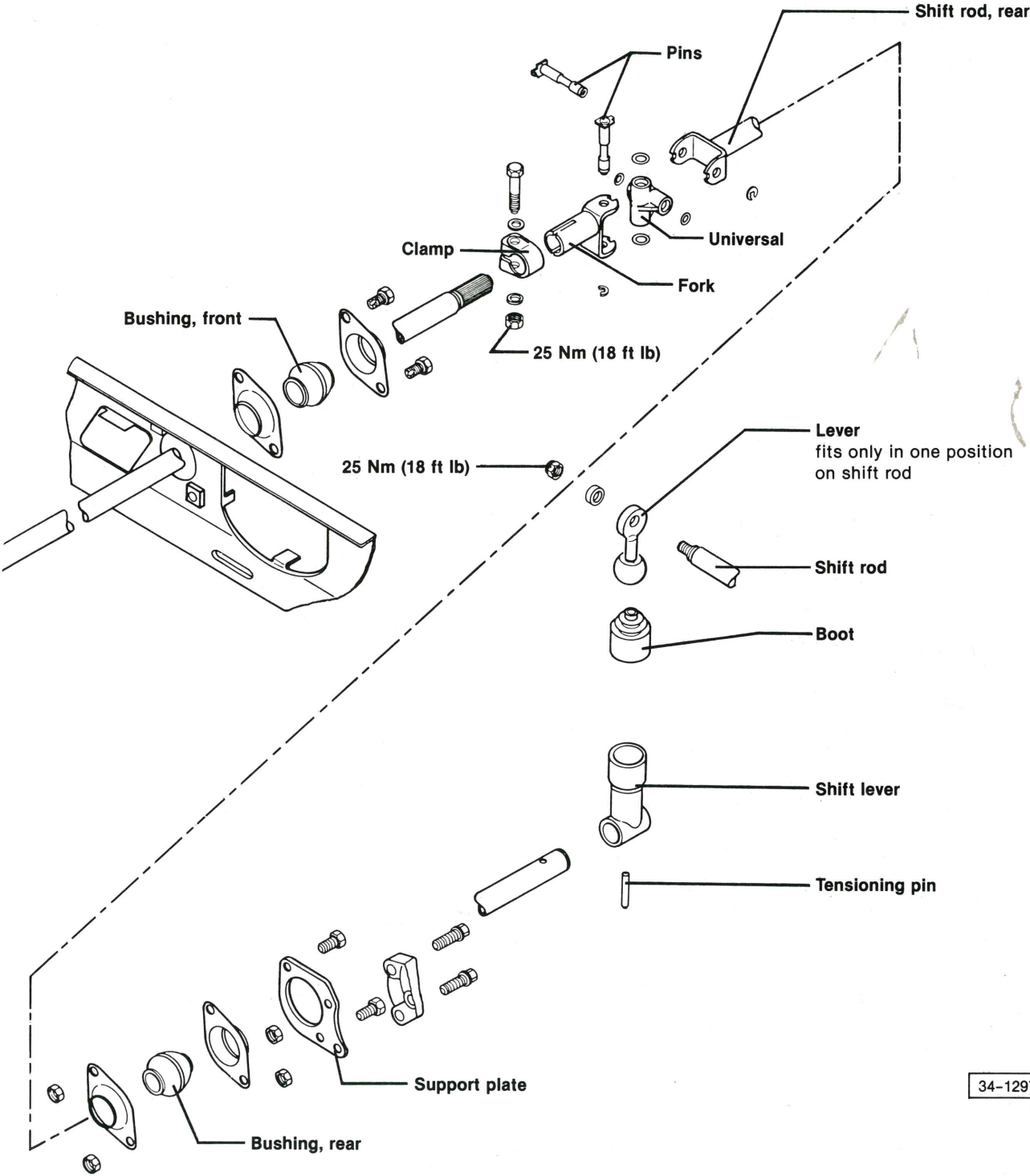
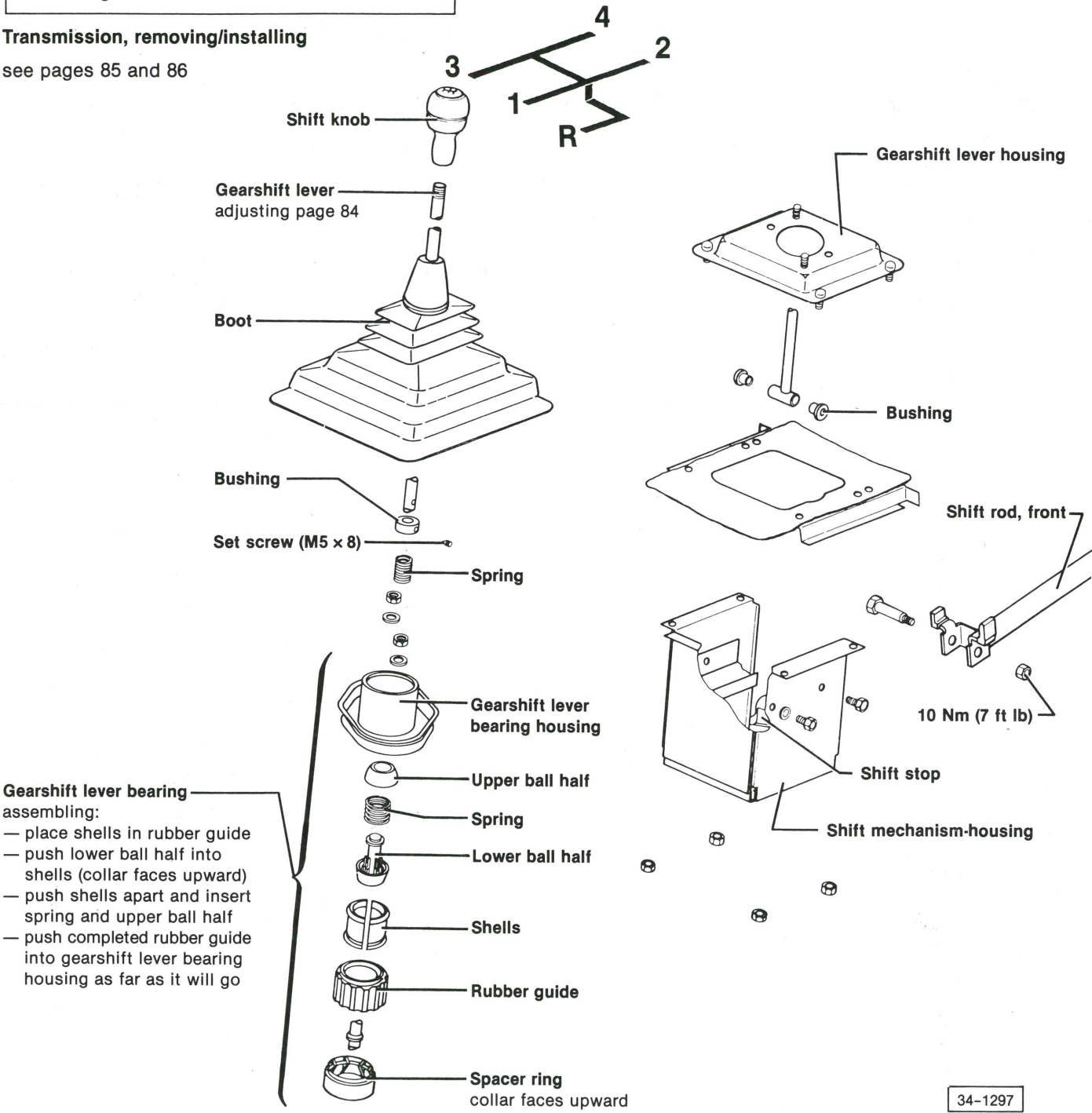


- remove circlip
- to avoid bending trigger wheel when prying off, insert screwdrivers through two opposing slots until they contact circlip
- check that trigger wheel turns freely after installation by turning distributor shaft
 - if trigger wheel is bent, it must be replaced

Notes

CAUTION
Lubricate all joints and moving parts with grease (Part No. A0S 126 000 05) before installing

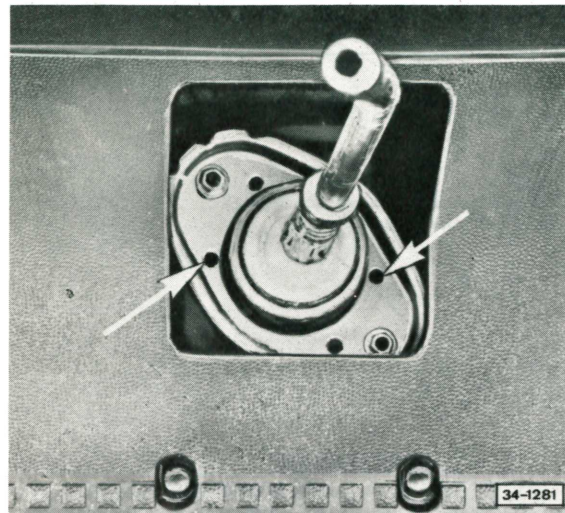
Transmission, removing/installing
see pages 85 and 86



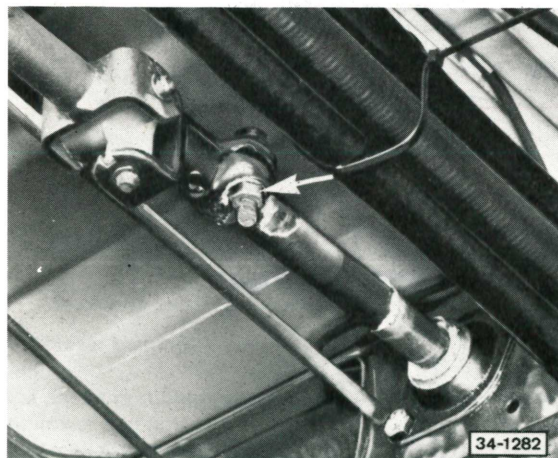
Gearshift lever, adjusting

Work sequence

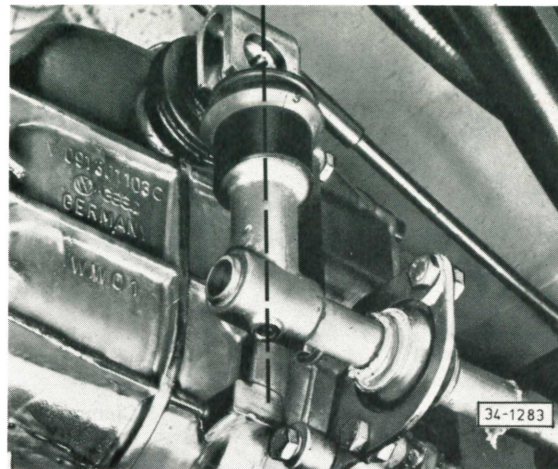
- shift into neutral position



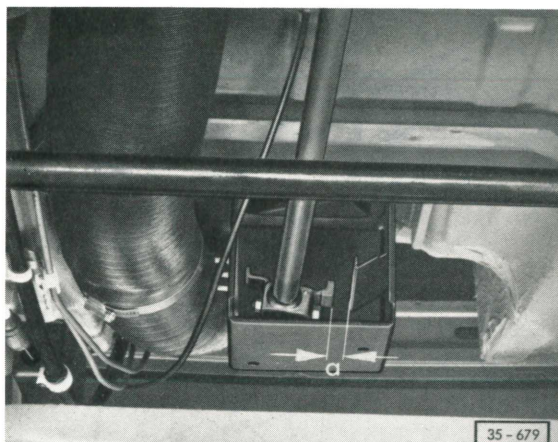
- align centering holes (arrows) of gearshift lever housing and gearshift lever bearing housing



- loosen clamp nut (arrow)
- check that joints of shift rods slide freely
- remove spare wheel



- set lever on transmission in vertical position, as shown



- move stop finger of front shift rod to center of shift mechanism housing
- adjust shift rod end
 - $a = 23 \text{ mm}$ (29/32 in.) (use strip of sheet metal to measure)

CAUTION

Transmission must be in neutral, lever on transmission in vertical position

- tighten shift rod clamp
- shift through all gears and check that they engage easily without jamming
- check reverse lock-out for proper operation

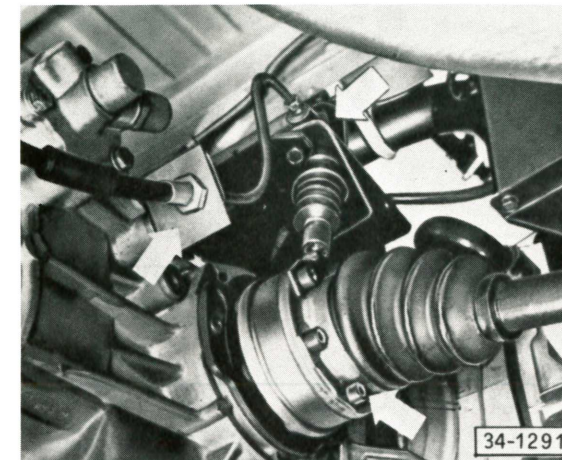
Note

Check that with 1st gear engaged, distance between shift lever and heater pipe insulation of min. 15 mm (19/32 in.)

Transmission, removing (engine installed)

Work sequence

- disconnect battery ground strap
- remove upper engine/transmission bolt
- remove bracket for accelerator cable

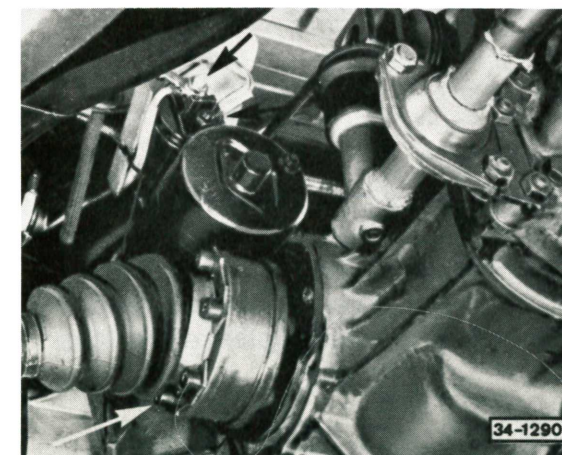


- remove left drive shaft from transmission and hang up with wire
- remove clutch cable bracket from transmission
- remove clutch slave cylinder from bracket and hang up with wire

Note

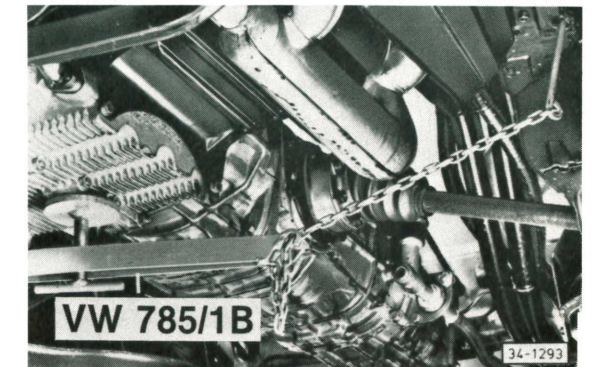
Hydraulic system must be closed

- disconnect backup light wiring

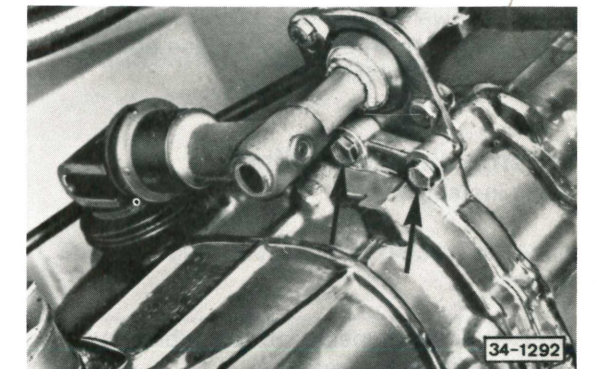


- disconnect starter wiring and remove starter complete

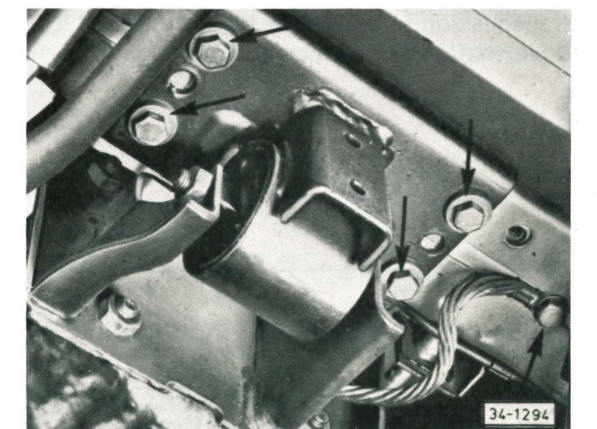
- remove right drive shaft from transmission and hang up with wire



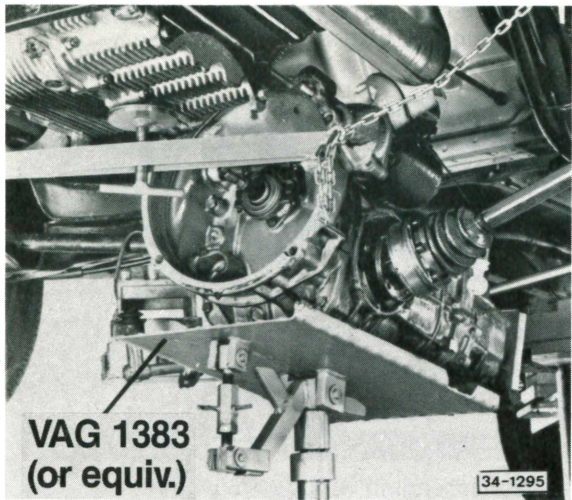
- support engine with VW 785/1B
- remove rubber plugs from left wheel housing to hook in chain



- remove shift rod from transmission (arrows)
- support transmission with suitable tool



- remove ground strap from body (right arrow)
- remove front transmission mount from body (arrows)



- lower front part of transmission (loosen spindle of VW 785/1) until there is enough room to remove transmission
- remove lower engine/transmission bolts
- pull transmission off engine guide bolts and remove from vehicle

Transmission, installing
(engine installed)

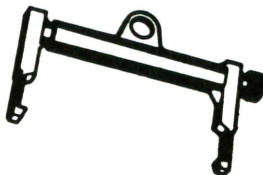


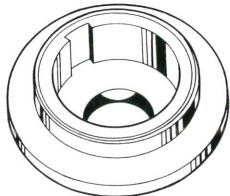
Proceed in reverse order of removing and note following:

- clean splines of mainshaft and lubricate lightly with MoS₂ grease
- finally tighten front transmission mounts

Tightening torques:

- transmission to engine (M 10) 30 Nm (22 ft lb)
- drive shafts to transmission 45 Nm (33 ft lb)

Special Tools

TOOL/EQUIPMENT		APPLICATION	
3092	Extractor for cylinder liners	Engine Assembly	Assy Group 10
		Remove cylinder sleeve	
			
T03 092 000 10 ZEL			
3090	Support for connecting rods	Engine—Crankshaft Assembly	Assy Group 13
		Support connecting rod	
			
T03 090 000 13 ZEL			
3091	Tool for removing and installing piston pins	Engine—Assembly	Assy Group 10
		Remove and install piston pin	
			
T03 091 000 10 ZEL			
3088	Tool for installing crankshaft oil seal (drive pulley side)	Engine—Crankshaft Assembly	Assy Group 13
		Install crankshaft oil seal (pulley side)	
			
T03 088 000 13 ZEL			

NEW VEHICLE DELIVERY INSPECTION

A) Install the Following Supplied Items:

Hub caps	x
Front license plate bracket (where applicable)	x

B) Preparatory Services:

Engine Oil Level: Check and add if necessary	x
Brake Fluid Level: Check and add if necessary	x
Battery: Check voltage with engine off, if less than 12.2 volts, RECHARGE	x
Battery Electrolyte Level: Check	x
Windshield Washer: Fill up	x
Coolant Level: Check antifreeze level and concentration, add if necessary	x
ATF Level: Check and add if necessary (where applicable)	x
Standard Transmission Final Drive: Check and add if necessary (where applicable)	x
Automatic Transmission Final Drive: Check oil and add if necessary (where applicable)	x
V-Belt(s) Tension: Check	x

C) Operation of Safety Items:

Door Locks Functioning: Check	x
Seat Operation and Adjustment: Check	x
Safety Belts, Locking Mechanism and Ignition Lock: Check	x
Brake System: All Brake Lines and Hoses Check visually	x
Headlights and high beam indicator	x
Parking lights	x

D) Check Operation Of

Stop lights	x
Turn signals and indicator	x
Emergency flasher and indicator	x
Taillights	x
Side marker lights	x
License plate lights	x
Backup lights	x
Horn	x
Windshield wipers and washer	x
Rear window defogger and indicator	x
Brake warning light	x
Alternator and oil pressure warning lights	x
Headlights: Check adjustment, correct if necessary	x
Wheel mounting bolts: Check tightness	x
Tire pressure (including spare wheel): Correct to specifications	x
Steering components, lock plates and cotter pins: Check visually	x
Tie rod ends and tie rods: Check visually	x

E) Road Or Dynamometer Test

Brake and parking brake: Check operation	x
Clutch and shifting of all gears, including kickdown: Check operation	x

LUBRICATION, EMISSION AND VEHICLE MAINTENANCE

At 1,000 Miles/1,500 km

1. Engine: Check oil level, add if necessary	x
2. Cooling System: Check coolant level, add if necessary	x
3. Brake System: Check for damage and leaks	x
4. Fuel System: Check visually for leaks	x

DURING Road Test

5. Check efficiency of braking, kickdown (where applicable), steering, heating and ventilation system	x
---	---

AFTER Road Test

6. Engine Idle Speed: Check and adjust if necessary	x
7. Exhaust System: Check for damage and leaks	x
8. Engine: Check for leaks	x

LUBRICATION, EMISSION AND VEHICLE MAINTENANCE

Every 7,500 Miles/12,000 km

- 1. Change oil x
- 2. Engine: Replace oil filter (at the first 7,500 miles/12,000 km and at the 15,000 mile/24,000 km maintenance intervals thereafter) x
- 3. Brake System: Check for damage and leaks, check thickness of brake pads x

LUBRICATION, EMISSION AND VEHICLE MAINTENANCE

At 15,000 Miles/24,000 km & 45,000 Miles/72,000 km

- 1. Engine: Change oil, replace oil filter x
- 2. Cooling System: Check coolant level, add if necessary x
- 3. Ignition Wires, Distributor Cap and Rotor: Check visually, replace if necessary x
- 4. V-Belts: Check tension and condition. Adjust if necessary—49 States. (Also rec. for California vehicles) x
- 5. Crankcase Ventilation System: Check visually x
- 6. Fuel System: Check visually for leaks x
- 7. Fuel Filter: Replace (49 States only) x
- 8. Manual Transmission: Check oil level, add if necessary x
- 9. Automatic Transmission Final Drive: Check oil level add if necessary x
- 10. Brake System: Check for damage and leaks x
- 11. Brake Linings and Pads: Check thickness x
- 12. Brake Fluid: Check level, add if necessary x
- 13. Wheels and Tires: Check for wear and damage x
- 14. Front Axle: Check dust seals on ball joints and dust seals on tie rod ends, check tie rods x
- 15. Steering and drive shafts: Check boots x
- 16. Headlights: Check, adjust if necessary x
- 17. Door Check Rods: Lubricate x
- 18. Sliding door mounting points, guide tracks, roller guides: Lubricate x

DURING Road Test

- 19. Check efficiency of braking, kickdown (where applicable), steering, heating and ventilation systems x

AFTER Road Test

- 20. Engine Idle Speed: Check, adjust if necessary (49 States) x
- 21. Automatic Transmission: Check ATF level x
- 22. Exhaust System: Check for damage and leaks x
- 23. Engine: Check for leaks x

LUBRICATION, EMISSION AND VEHICLE MAINTENANCE

Notes

At 30,000 Miles/48,000 km & 60,000 Miles/96,000 km:

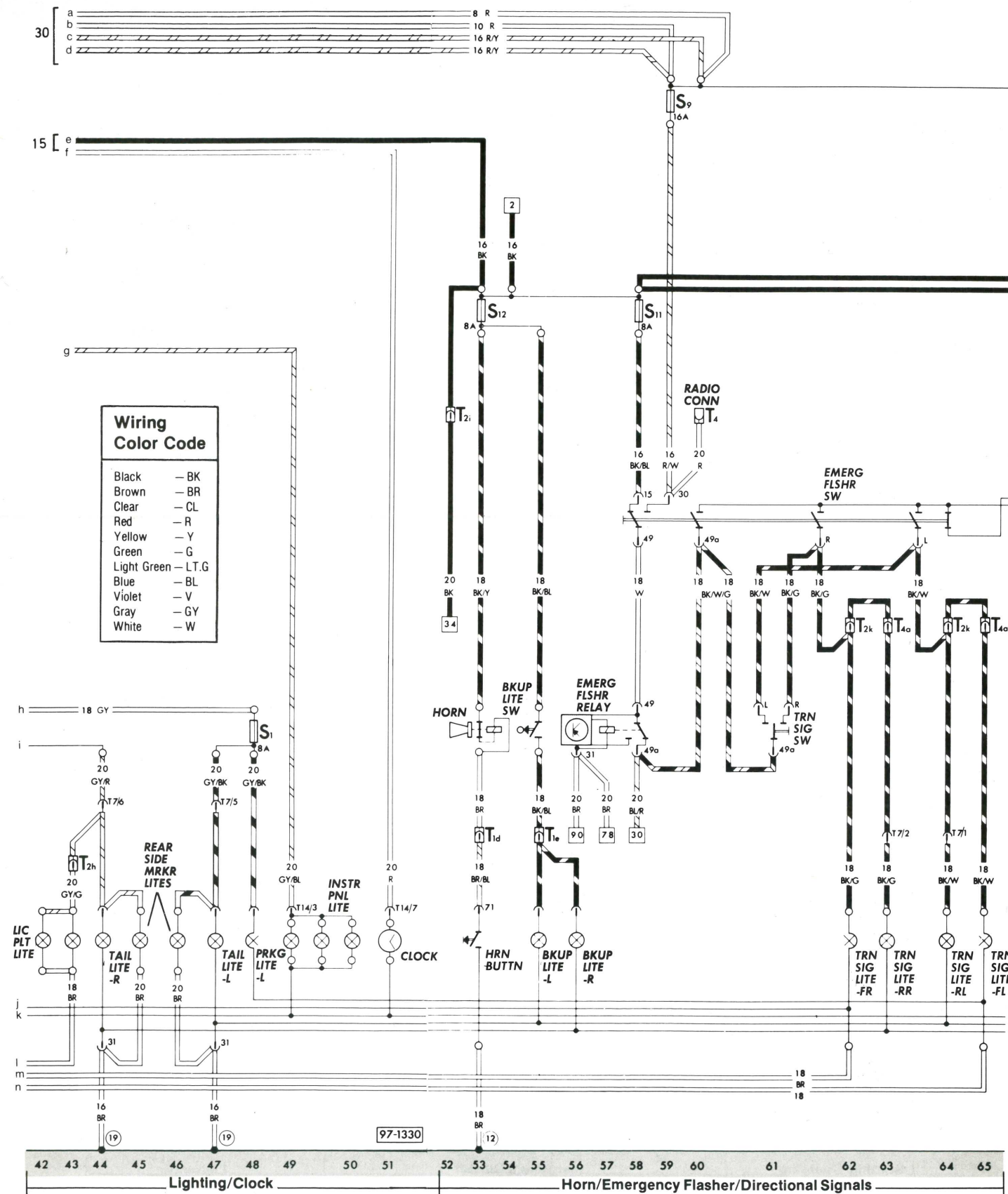
- | | |
|--|---|
| 1. Engine: Change oil, replace filter | x |
| 2. Cooling System: Check coolant level, add if necessary | x |
| 3. Automatic Transmission: Change ATF, clean pan, strainer, replace gasket | x |
| 4. Valve Cover Gasket: Replace | x |
| 5. Spark Plugs: Replace | x |
| 6. Ignition Wires, Distributor Cap and Rotor: Check visually, replace if necessary | x |
| 7. Compression: Check | x |
| 8. V-Belt(s): Check tension and condition, replace/adjust if necessary, (also recommended for California vehicles) | x |
| 9. Crankcase Ventilation System: Check visually | x |
| 10. Fuel System: Check visually for leaks | x |
| 11. Air Cleaner: Replace filter element | x |
| 12. Fuel Filter: Replace (49 States) | x |
| (California vehicles replace at 60,000 Miles/96,000 km) | |
| 13. Manual Transmission: Check oil level, add if necessary | x |
| 14. Automatic Transmission Final Drive: Check oil level, add if necessary | x |
| 15. Brake System: Check for damage and leaks | x |
| 16. Brake Linings and Pads: Check thickness | x |
| 17. Brake Fluid: Replace every 2 years regardless of mileage | x |
| 18. Brake Warning Light Switch: Check functioning | x |
| 19. Wheels and Tires: Check for wear and damage | x |
| 20. Front Axle: Check dust seals on ball joints and tie rod ends, check tie rods | x |
| 21. Steering and Drive Shafts: Check boots | x |
| 22. Headlights: Check and adjust if necessary | x |
| 23. Door Check Rods: Lubricate | x |
| 24. Sliding door mounting points, guide tracks, roller guides: Lubricate | x |
| 25. Oxygen Sensor: Replace, reset mileage counter | x |

DURING Road Test

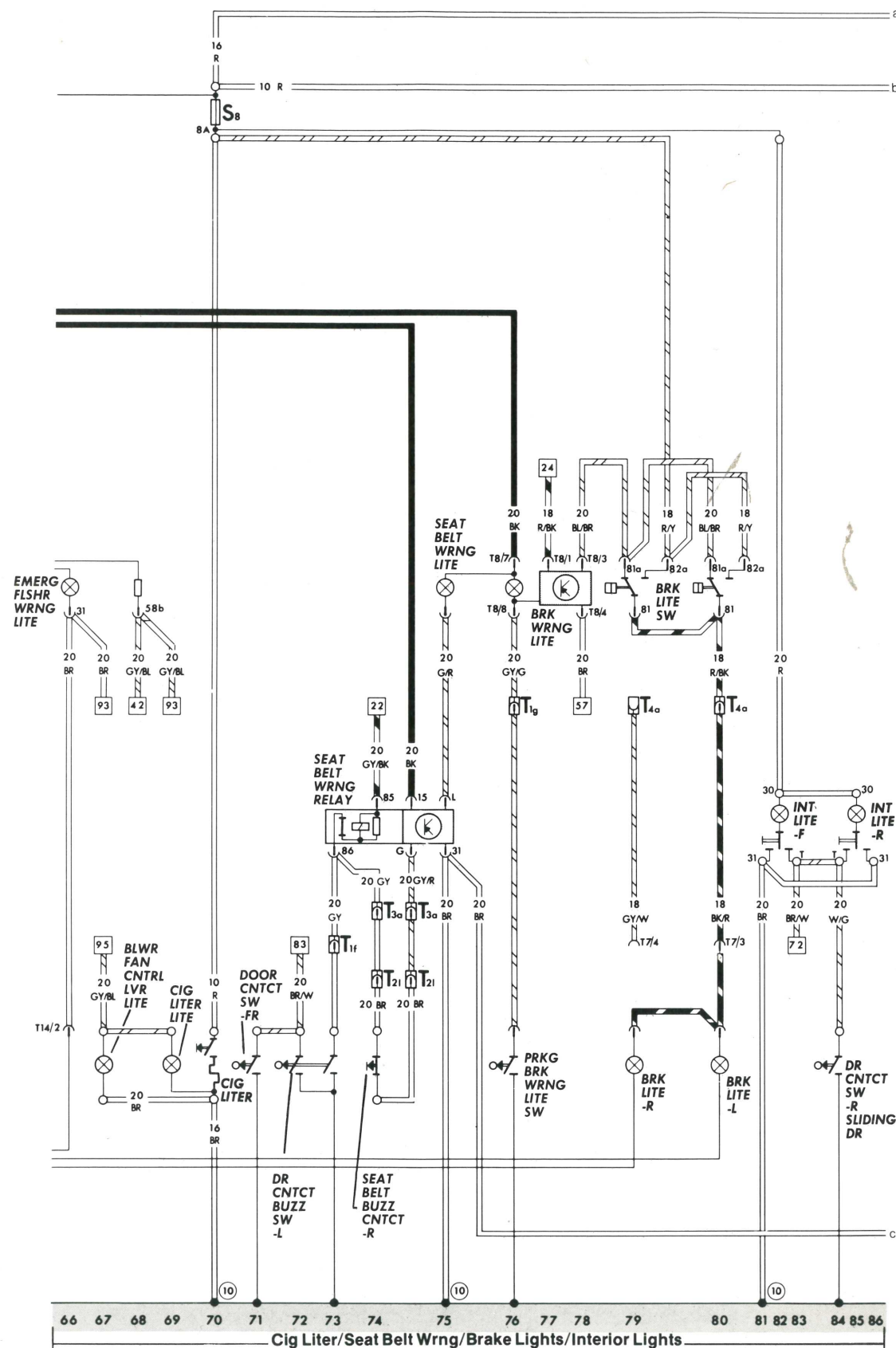
- | | |
|--|---|
| 26. Check efficiency of braking, kickdown (where applicable), steering, heating and ventilation system | x |
|--|---|

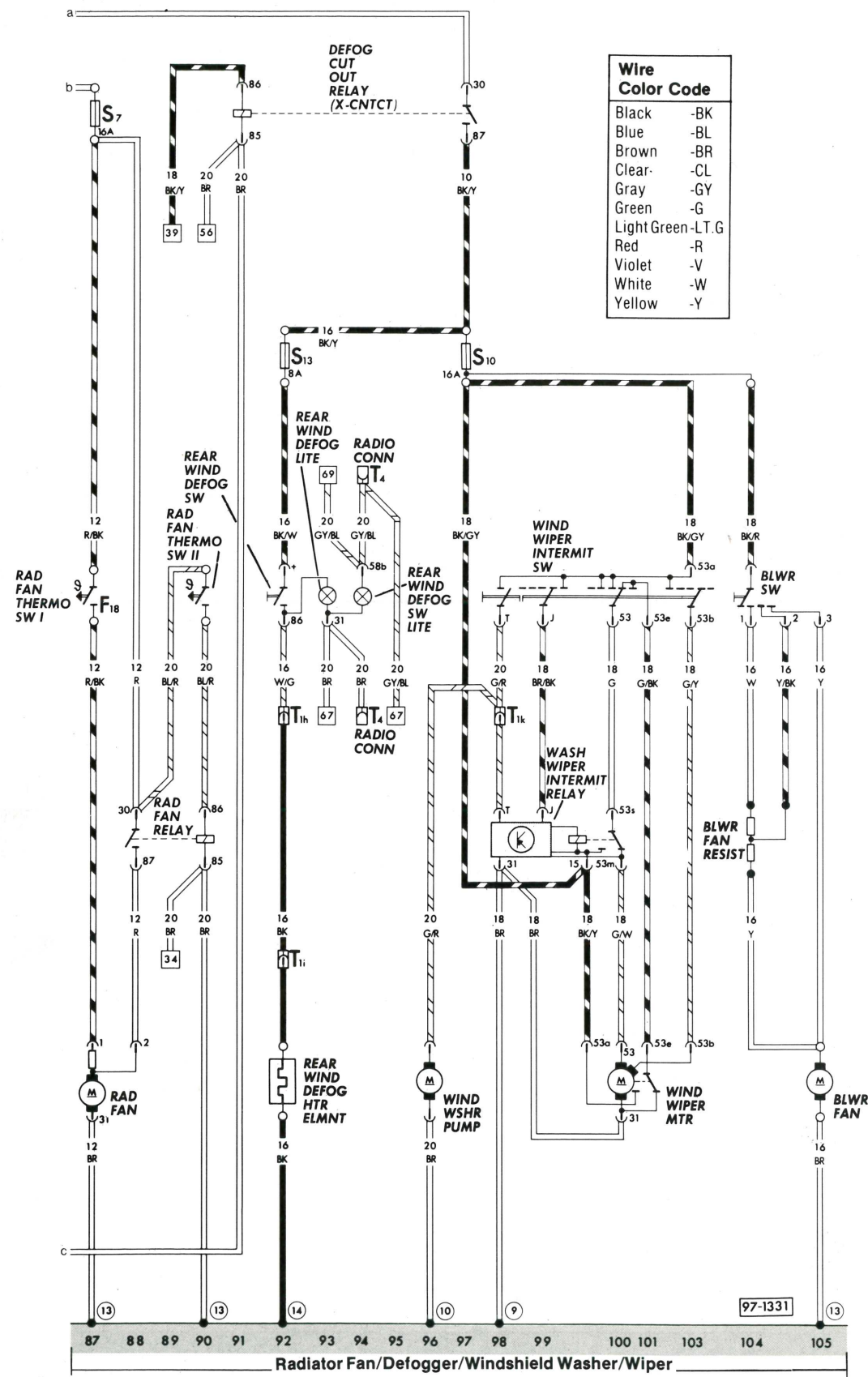
AFTER Road Test

- | | |
|---|---|
| 27. Engine Idle Speed: Check, adjust if necessary | x |
| 28. Exhaust System: Check for damage and leaks | x |
| 29. Engine: Check for leaks | x |
| 30. Automatic Transmission: Check ATF level, add if necessary | x |
| 31. Brake Fluid: Top up | x |



Note: All wire sizes American Wire Gauge





Description	Current Track
Air flow sensor	8, 9
Alternator	24-26
Alternator warning light	26
Auxiliary air regulator	13
Battery	20
Back-up light, left	55
Back-up light, right	56
Back-up light switch	55
Blower fan	105
Blower-fan control-lever light	67
Blower-fan resistance	104
Blower switch	104, 105
Brake light, left	80
Brake light, right	79
Brake-light switch	79, 80
Brake warning light	66
Cigarette lighter	70
Cigarette-lighter light	69
Clock	51
Coolant low-level-warning control unit	33, 34
Coolant low-level-warning switch	33
Coolant over-temperature warning light	34
Coolant-temperature gauge	32
Coolant-temperature sending unit	32
Defogger cut-out relay (X-contact)	91-97
Door contact/buzzer switch, left	72, 73
Door contact switch, front right	71
Door contact switch, right sliding door	84
Emergency flasher relay	56-58
Emergency-flasher switch	58-68
Emergency-flasher warning light	66
Fuel control unit	6-15
Fuel gauge	31
Fuel-gauge sending unit	31
Fuel pump	18
Fuel pump relay	18, 19
Full-throttle enrichment switch	11
Fuses (S1-S13) on fuse/relay panel	-
Hall generator	4, 5
Headlight dimmer/flasher switch	38-40
Headlight-high-beam light	36
Headlight, left	37, 39
Headlight, right	38, 40
Horn	53
Horn button	53
Idle stabilizer	4, 5
Idle switch	4, 5
Ignition coil	1-3

Description	Current Track
Ignition distributor	1-3
Ignition/starter switch	22-27
Injector cylinder 1	11
Injector cylinder 2	12
Injector cylinder 3	13
Injector cylinder 4	14
Instrument panel light dimmer	49, 50
Instrument-panel light	42
Interior light, front	81-83
Interior light, rear	84-86
License plate light	42, 43
Light switch	40-42
Oil-pressure switch (1.8 bar)	29
Oil pressure warning light	29
Oxygen sensor	7
Oxygen sensor elapsed-milage indicator light	28
Oxygen-sensor elapsed milage switch	28
Parking light, left	48
Parking light, right	41
Parking-brake warning light switch	76
Power supply relay	16, 17
Radiator fan	87
Radiator-fan rlay	88-90
Radiator-fan thermostwitch I	87
Radiator-fan thermostwitch II	90
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Description	Current Track
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Wire connectors	
T1	-single, in engine compart. left
T1a	-single, in connector housing
T1b	-single, in connector housing
T1c	-single, near alternator in engine compart.
T1d	-single, behind dash
T1e	-single, in connector housing
T1f	-single, behind dash
T1g	-single, behind dash
T1h	-behind dash
T1i	-at roof cross-beam, rear right
T1k	-single, behind dash
T2	-double, on fuse/relay panel
T2a	-double, behind dash
T2b	-double, behind dash
T2c	-double, behind dash
T2d	-double, behind dash
T2e	-double, in connector housing
T2f	-double, behind dash
T2g	-double, in connector housing
T2h	-double, in connector housing
T2i	-double, in connector housing
T2k	-double, behind dash
T2l	-double, below driver's seat
T3	-3 point, near alternator in engine compart.
T3a	-3 point, behind dash
T4	-4 point, behind dash
T4a	-4 point, behind dash
T7	-7 point, in connector housing
T8	-8 point, behind dash, near brake warning lights
T14	-14 point on instrument cluster

Ground connectors	
①	-from battery to body
②	-from transmission to body
⑨	-behind dash near fuse/relay panel
⑩	-behind dash
⑫	-at steering-gear housing
⑬	-behind air vent
⑭	-at rear deck
⑮	-near fuel pump at floor board/crossmember
⑰	-near ignition distributor
⑱	-left at cylinder head
⑲	-near ignition coil, in engine compart., left
⑳	-plus connection, in connector housing

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