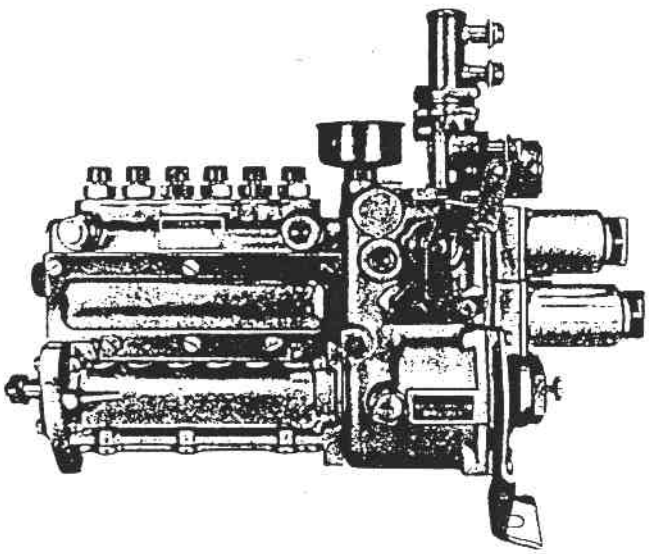
BOSCH

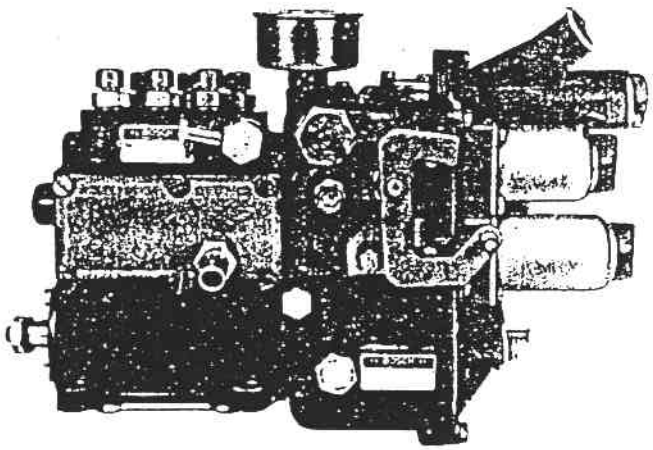
REPAIR INSTRUCTIONS
INSTRUCTIONS DE RÉPARATION
INSTRUCCIONES DE REPARACIÓN

EP

VDT-WJP 711/1 B
Ed. 2

B ~~9.64~~ + Sup. ~~9.67~~





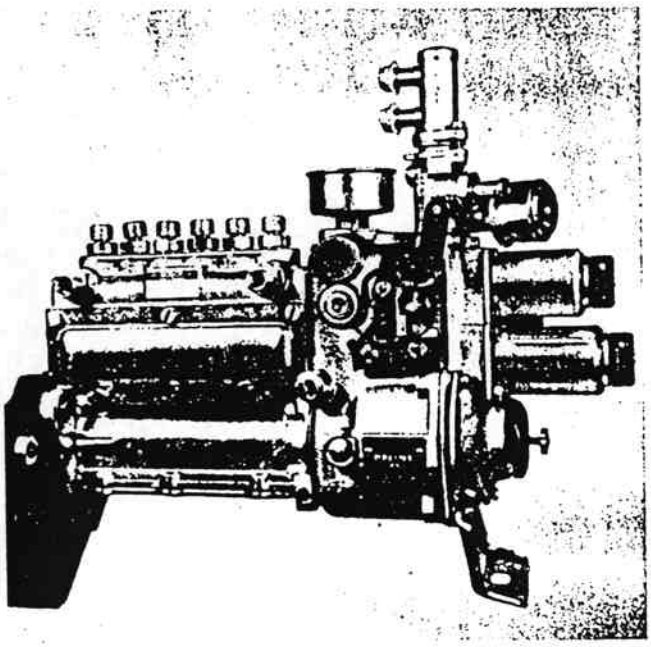
Gasoline injection pump
Pompe d'injection à essence
Bomba de inyección de gasolina

with mechanical governor
avec régulateur mécanique de mélange
con regulador mecánico de la mezcla

0 418 076.. PES 6 KL..
0 418 078.. PES 8 KL..
0 418 266.. PED 6 KL..

0 428 023.. EP/ RLA..

Contents



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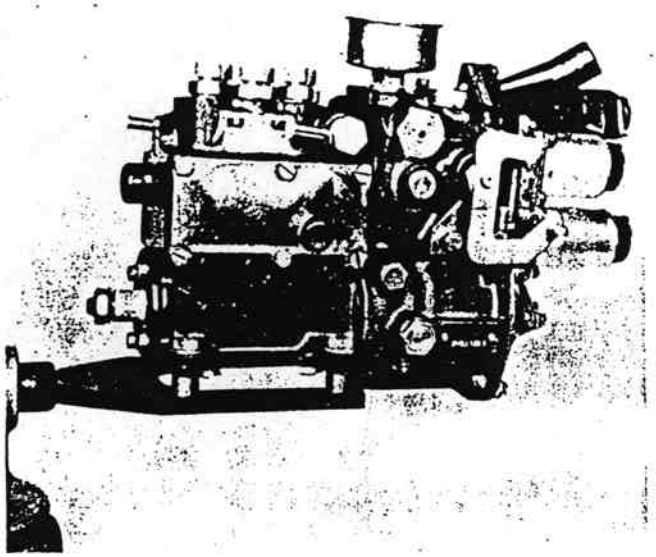

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1. Introduction

These instructions VDT-WJP 711/1 B describe disassembly, repair of components and assembly of gasoline injection pumps PES.. KL../.., ..A.., ..B. and PED..KL.. with mechanical governor EP/RLA...

With the introduction of the "A" and "B" versions of in-line pump PES..KL.. a number of modifications were incorporated and these must be borne in mind when carrying out repair work. These special aspects are pointed out in the sections covering the operations in question.

The double in-line pump PED..KL.. is a new design fitted for the first time as a 6-cylinder version to Porsche models 911 E and 911 S (2.0 and 2.2 litres).

The special constructional features of this pump are described in "Information on new products" VDT-BEP 701/2. Before carrying out any repair work it is advisable to become fully familiar with the content of this information bulletin.

The EP/RLA.. governor fitted differs from the versions previously fitted to in-line pumps only by the incorporation of an air thermostat horizontally flange-mounted to the governor cover and acting on the guide assembly in the compensating unit through the rocker.

These instructions are based on the single in-line pump but also apply fully to the double in-line pump because any deviating features or operations are described additionally.

2. Disassembly

2.1 Clamping the pump

In-line pump: Secure clamping flange 1 685 720 018 – EFEP 157/6 to flange of pump.

Insert universal clamping bracket 1 688 040 009 – EFEP 157/20 into clamping support 0 681 240 048 – EF 8498.

Insert pump and flange into universal clamping bracket and clamp in position.

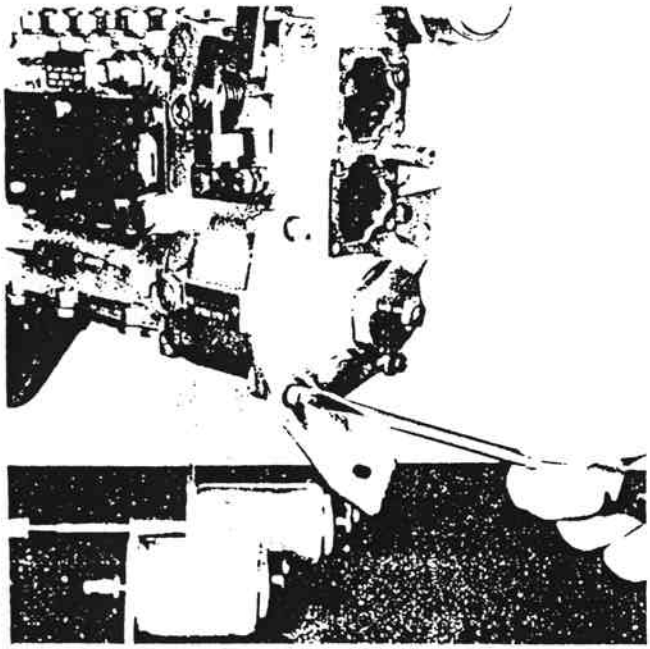
Fit drive coupling to camshaft taper . Fig. 1

Double in-line pump: Insert clamping fixture KDEP 1006 into clamping support 0 681 240 048 – EF 8498.

Screw pump to fixture. Fit drive coupling to camshaft taper. Fig. 2

2.2 Disassembling the governor

Unscrew start/stop solenoid from governor cover. In the case of PED..KL.. unscrew air thermostat from governor cover. Note insulating washers, seal and any spacing washer.
Remove governor cover and any support brackets.



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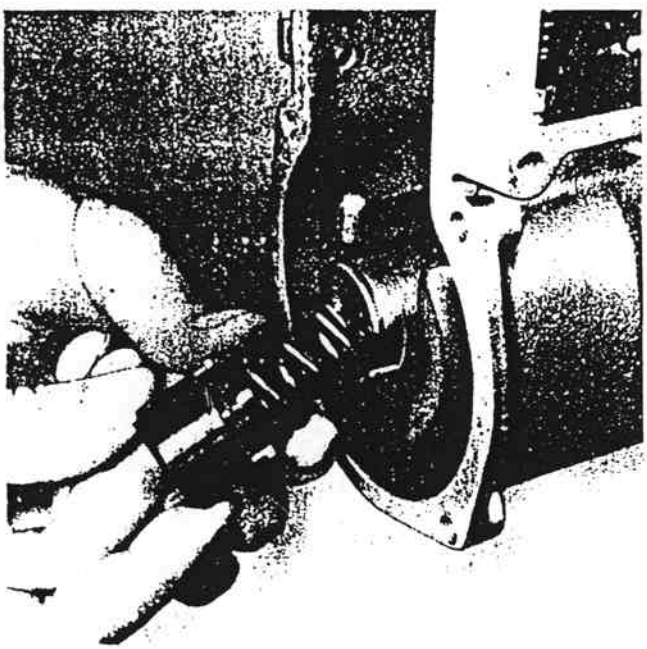
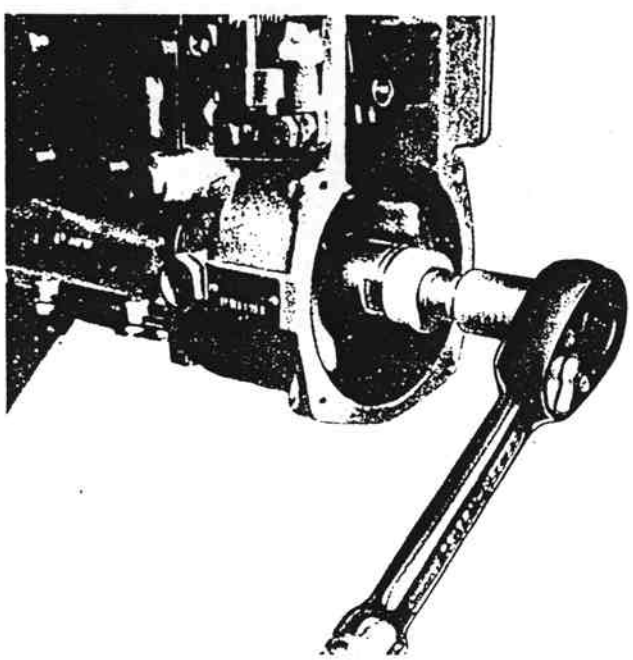
Using a commercially available pair of retainer pliers, remove retainer from spring retainer of flyweight assembly. Caution: do not open retainer too wide.
Withdraw spring retainer, the three governor springs, spring seat and guide plate from flyweight assembly.



4

With pronged wrench 1 687 950 012 – EFEP 187 A release and unscrew the flyweight assembly ring nut. Oppose rotation with assembly wrench 1 683 080 000 – EFEP 119 applied to the opposite end i.e. to the drive coupling.



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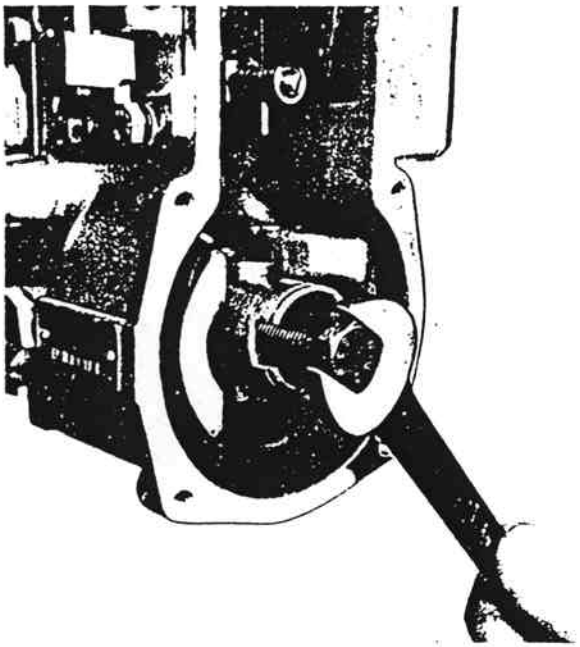

With puller 1 683 103 000 – EFEP 337 remove flyweight assembly from camshaft taper. For this purpose insert crosspiece of puller into aperture in flyweight assembly subsequently screwing the puller screw into the crosspiece. The screw must press on the center of the camshaft.

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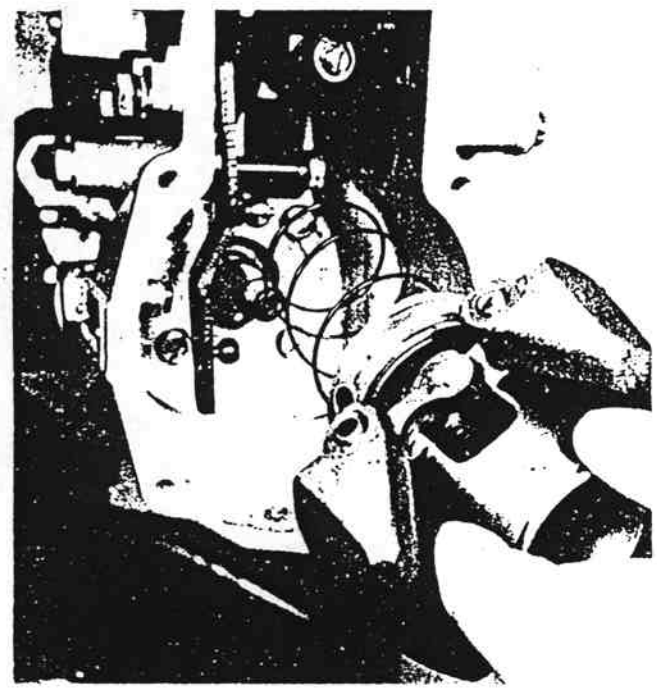

Slightly withdraw flyweight assembly and 3-D cam, disengaging the cam adjusting lever from the cam.
Subsequently, completely remove flyweight assembly with cam and spring. When removing, note thrust washers on both faces of the cam.

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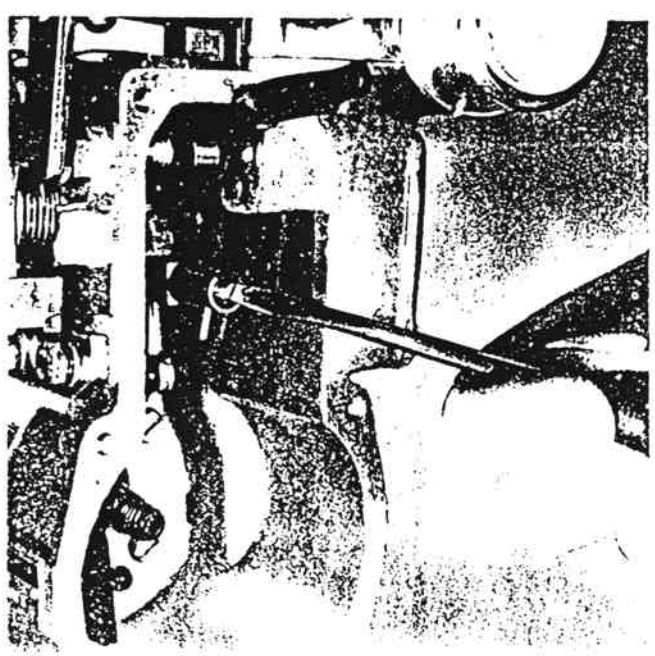

Unscrew control rod head.
Pull drive pin – without using force – out of guide in transfer lever of compensating unit. Note ratchet washer and spring.
Governors without starting solenoid have a modified control rod head which cannot be pushed "over center". The control rod is also modified to suit this control rod head.

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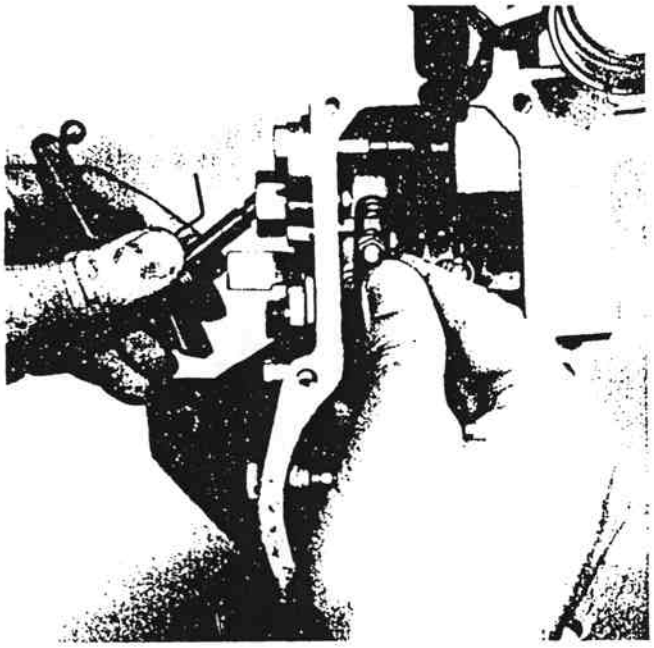
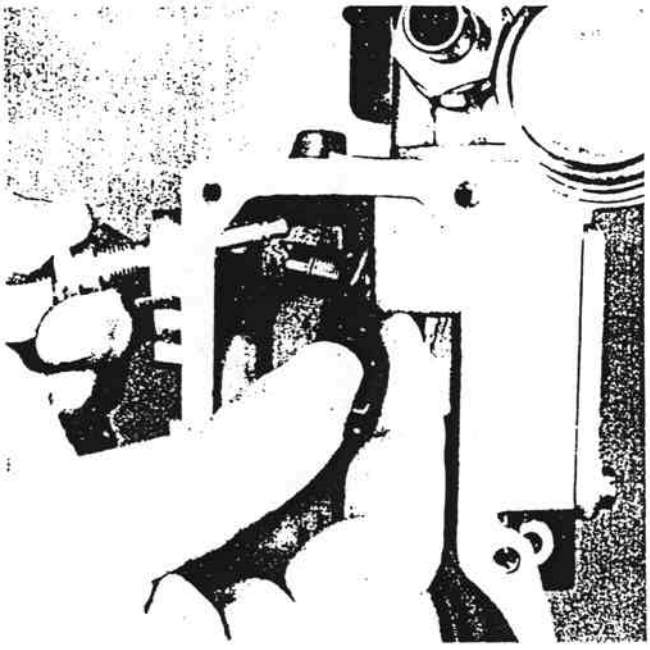


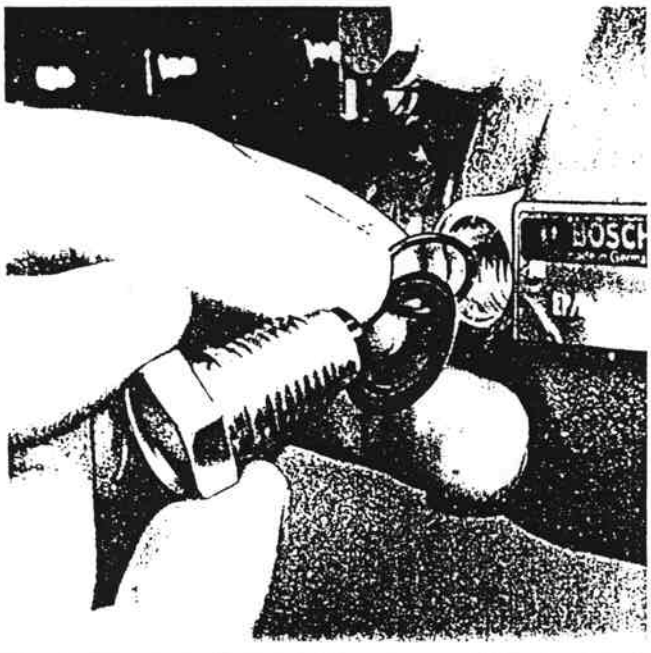
9

Remove outer control lever. For this purpose release nut of clamping screw in cam adjusting lever and remove cam adjusting lever from control lever shaft.
Unhook torsion spring and withdraw control lever shaft together with brazed-on control lever outwards out of bearing bushing.
Remove sealing ring from shaft.
Unscrew control lever shaft bearing bushing (hollow screw).
In the case of EP/RLA.. governors of older design, the cam adjusting lever is brazed onto the control lever shaft and the outer control lever is clamped on. In this instance first remove the control lever together with torsion spring. Subsequently unscrew the bearing bushing with shaft still in situ, whereupon shaft and cam adjusting lever can be simultaneously removed obliquely inwards.
Unscrew control lever stop.



10

On governors with starting solenoid, remove starting lever.
For this purpose unhook tension spring from roller lever.
Remove retainer from starting lever shaft. Unscrew shaft and simultaneously remove the starting lever from the shaft from inside. Unhook torsion spring.
On governors without start solenoid, unhook tension spring from roller lever.

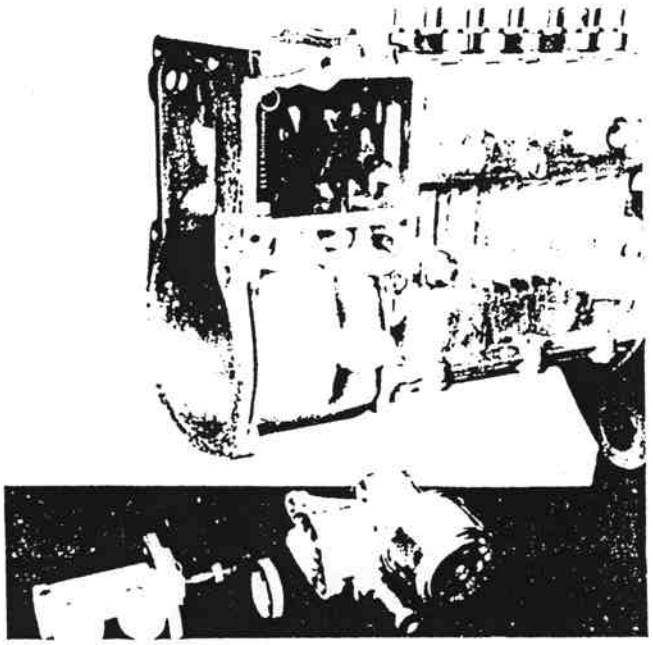


11

Unscrew spring-loaded guide capsule for cam adjusting lever. Also remove washers and O-Ring.
On EP/RLA.. governors of earlier design, a rigid mush-room-shaped buffer was incorporated and this was inserted into a bore in the interior of the governor housing.
Remove this buffer. It must not be used again when re-assembling and should be replaced by the spring-loaded version (in accordance with service parts list) (see illustration).

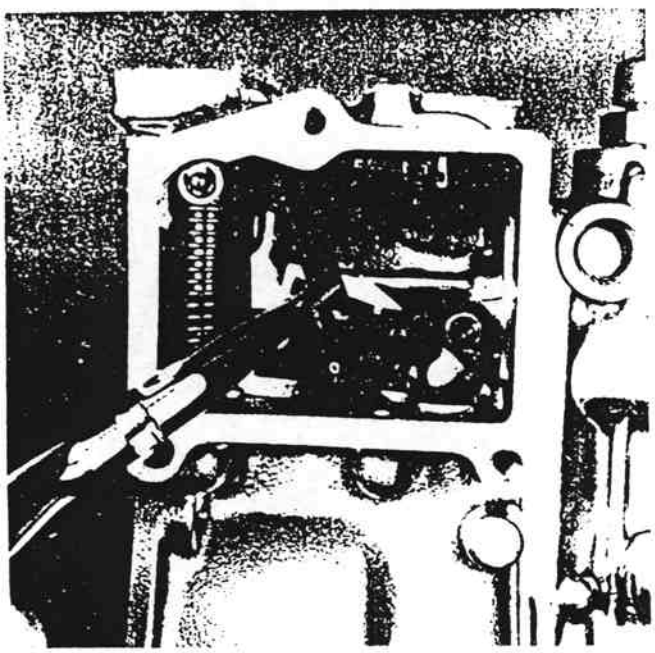
2.3 Disassembling the compensating unit

Unscrew altitude compensator together with washers and in the case of governors on PES..KL.. pumps unscrew control valve housing with warm-up thermostat.
Unscrew compensating unit cover.
On governors fitted to PED..KL.. pumps, remove small cover from compensating unit.



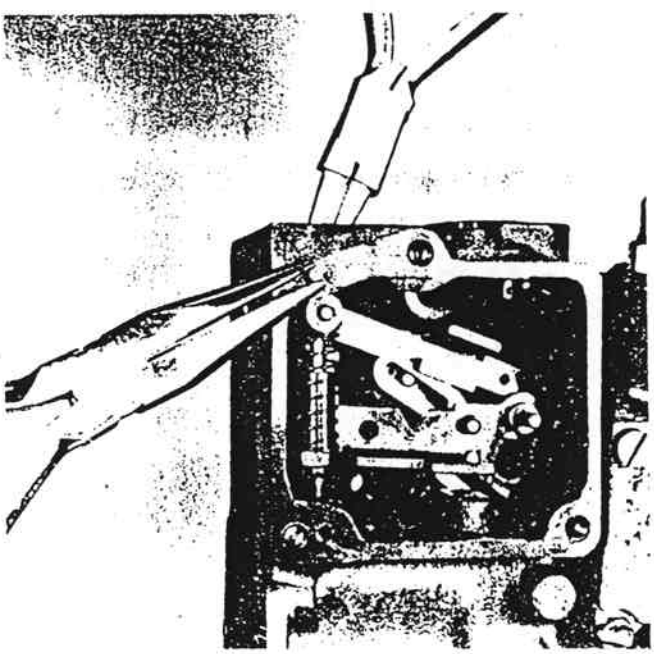
12

Unscrew small fillister-head screw from compensating unit, then take out the guide pin in upward direction. Unhook tension spring. (In the case of EP/RLA.. governors of older design, the tension spring is removed later – see Fig. 16).
Push correction lever downward slightly and remove link fork.



13

On governors with air thermostat on governor cover, push bearing pin for angle bracket outwards with thin-nose pliers so that the pin projects slightly from the housing. Now withdraw pin with pliers and remove angle bracket.



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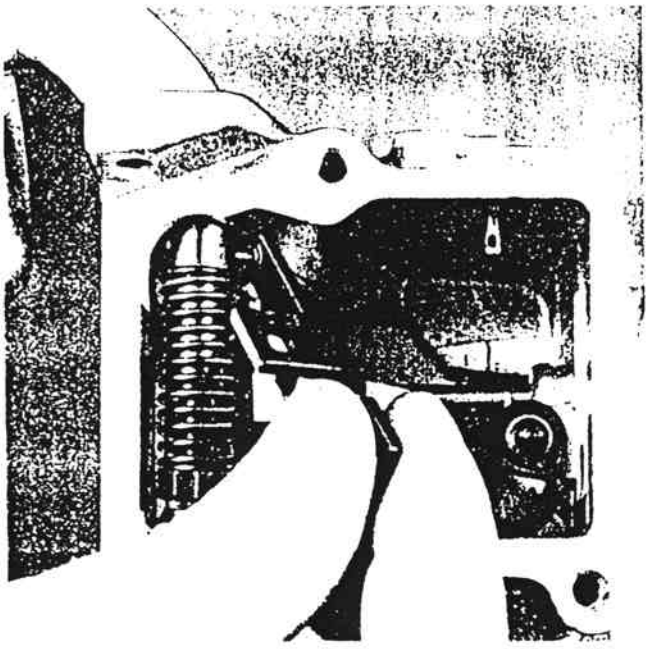
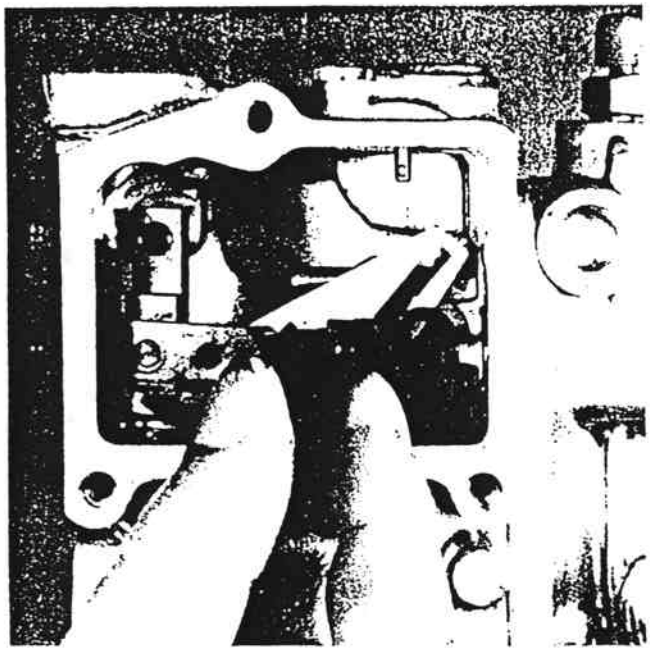


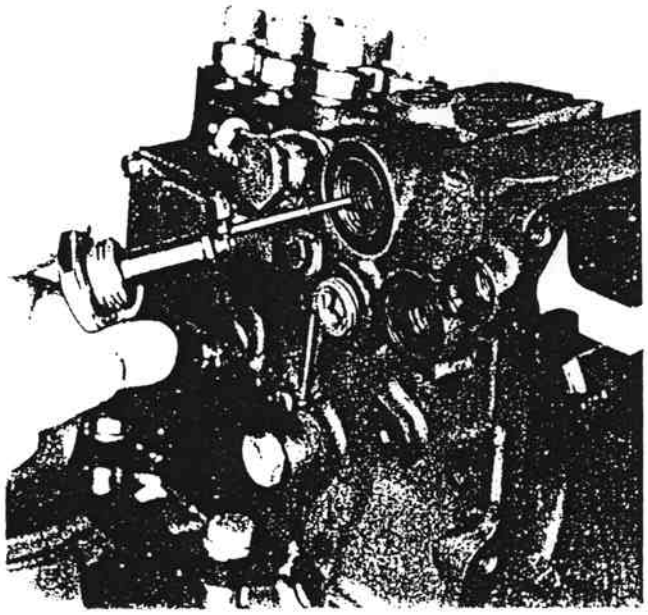
15

Remove retainer from rocker bearing pin and while pressing down on guide piece turn rocker and guide piece slightly and remove rocker.
Remove guide piece with its spring and spring seat (if fitted) through top hole. Release lock nut and unscrew guide pin of guide assembly.
Remove washer if fitted.



16

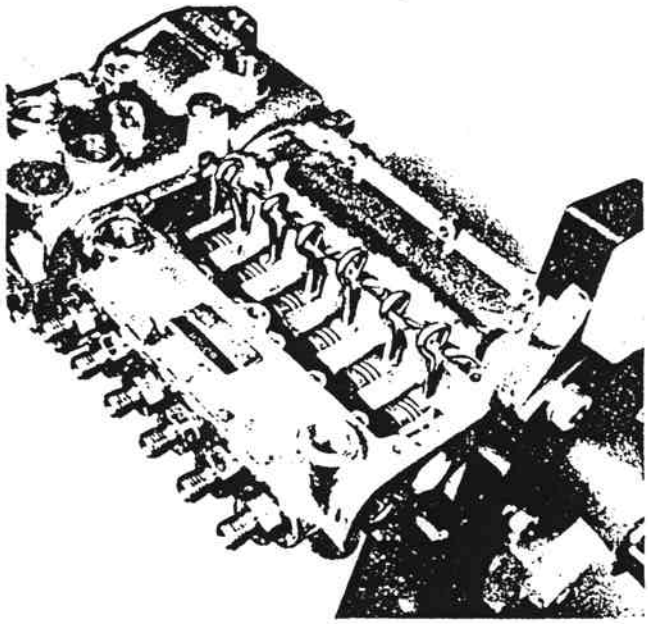
On EP/RLA.. governors of older design unhook tension spring.
Remove correction lever guide roller retainer and withdraw guide sleeve.
Remove retainer from bearing pin of swivel lever and detach correction lever with swivel and transfer lever.



17

On governors with altitude compensator at top right, remove connecting shaft for altitude correction.
For this purpose unscrew the screw serving as a bearing and remove together with connecting shaft.
Unscrew filter (where fitted) from governor housing.

2.4 Disassembling the injection pump

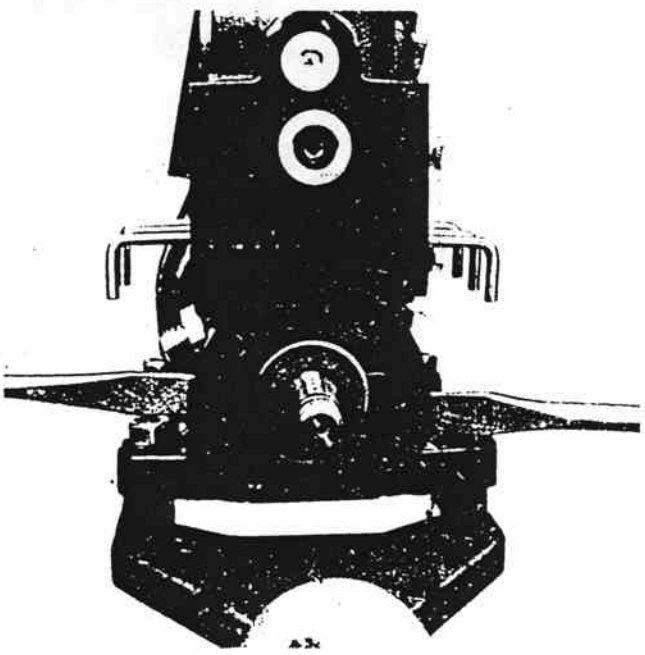


18

Unscrew spring compartment cover and base plate (On PES 8 KL.. L 13, the base plugs should be driven out in inward direction only after removing the camshaft).
Remove fuel delivery and return connections, oil delivery and return connections and any clamping jaws on the delivery valve holders.
Bring roller tappets to T.D.C. by rotating the camshaft and lock in position with suitable tappet holders: on PES..KL../.. introduce tappet holder 1 689 999 136 -- EFEP 308 A with inclined face **upwards** into locating bore in housing and into the retaining hole in the roller tappet. On PES..KL..A.. and PES..KL..B.. introduce tappet holder KDEP 1008 with inclined face **downwards** into retaining hole in roller tappet. Rotate tappet holder through 90° which will free the camshaft.

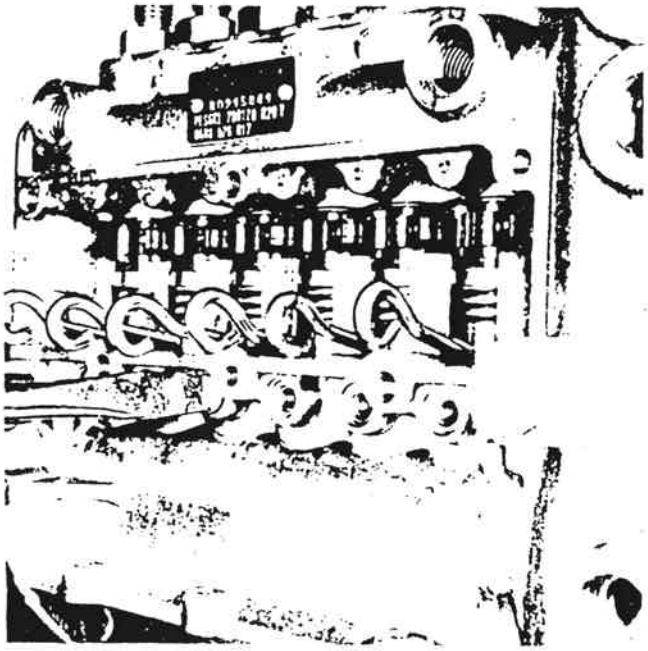
19

On PED..KL.. introduce eccentric pin KDEP 1007 with eccentric peg **downwards** into locating bore in housing and into retaining hole in roller tappet. Rotate eccentric pin through 180° which will free the camshaft.



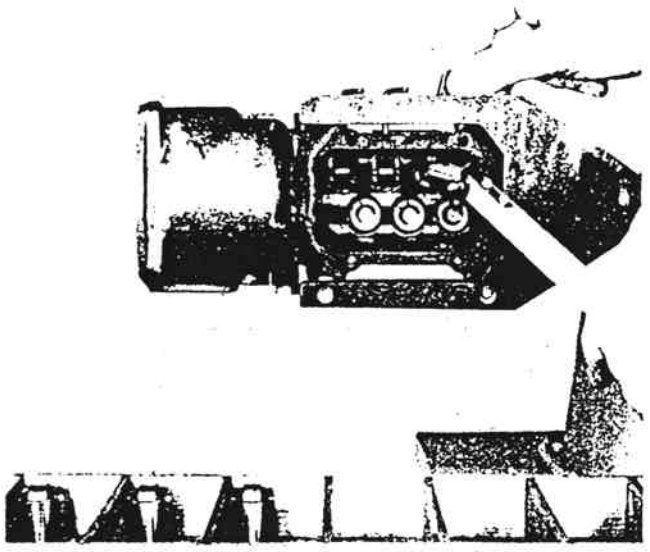
20

Unscrew fixing screws from bearing end plate on drive end (take pump with flange mounting from bracket). Insert two large screwdrivers into the recesses provided for this purpose on the bearing end plate and prise it off. Withdraw camshaft.



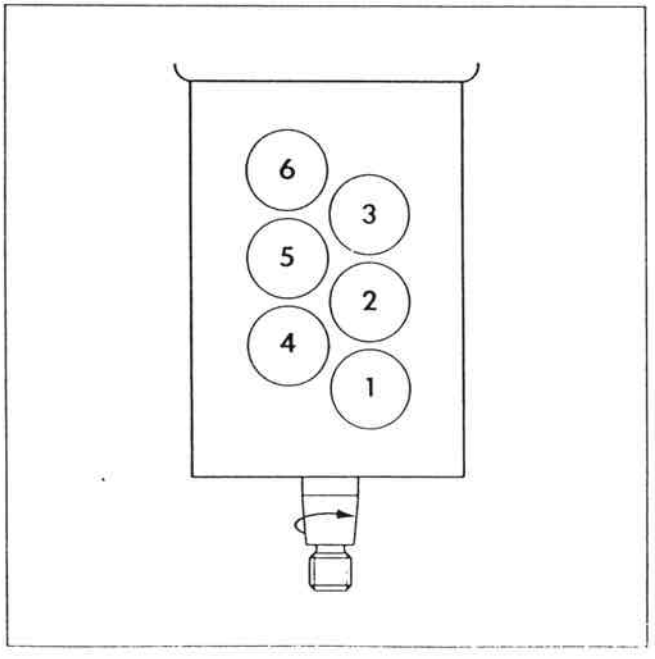
21

On PES..KL.. unscrew roller tappet guide screws. On PES 8 KL.. L 13, drive out the base plugs in inward direction.



22

Position pump horizontally.
With tappet clamp 1 683 083 000 – EF 8184 B push roller tappets upwards slightly to relieve the tappet holders. Withdraw tappet holders and remove roller tappets in downward direction.



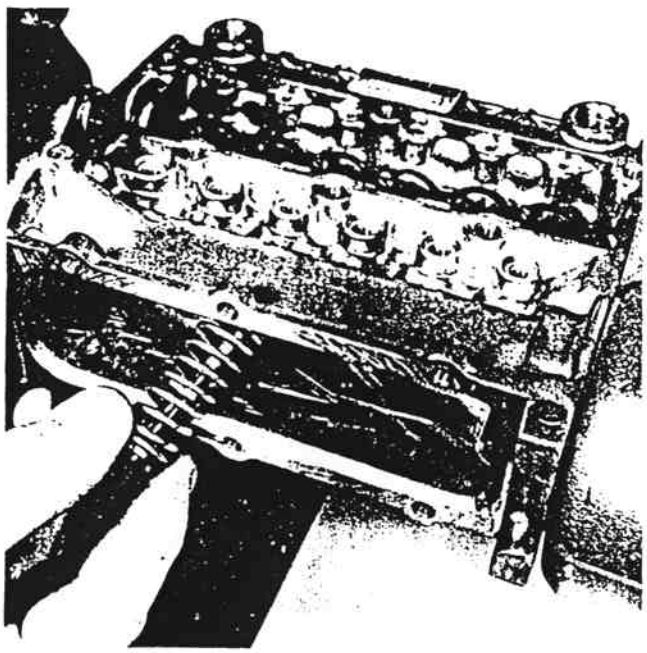
23

The roller tappets and subsequently the component parts of each pump element assembly should best be stored in a wooden box with compartments so that the individual working parts cannot be inadvertently interchanged (see Fig. 22).
In addition, and especially in the case of the double in-line pump, it is essential when removing and storing component parts to ensure that the same sequence – starting with pump element assembly 1 – is always maintained. The pump element assembly 1 is always the assembly closest to the drive. The sequence in the case of double in-line pumps is shown in Fig. 23.

Caution
The data concerning the plunger and barrel assembly sequence refer exclusively to the fuel injection pump and cannot in all cases be applied to the engine also.

Slacken clamping screws on gear segment. Fig. 24

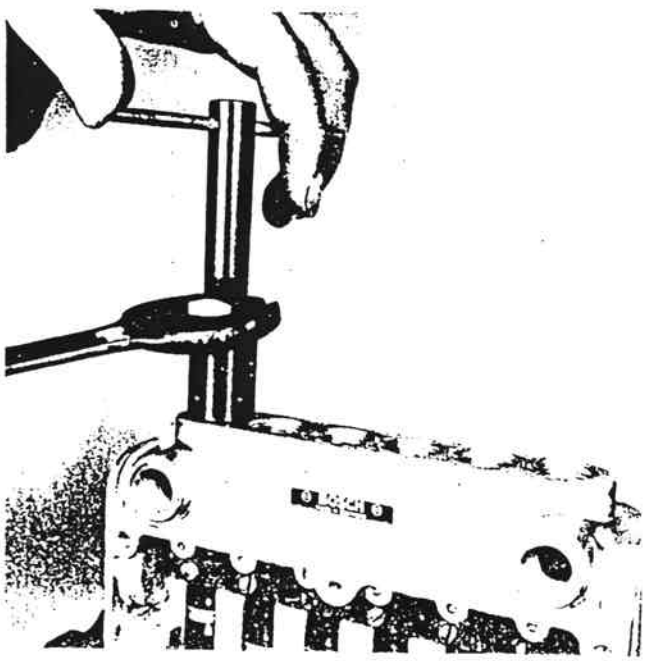
24 Remove pump plungers. When carrying out this work, remove plunger together with plunger base torsion spring and tappet spring, storing these components in correct sequence. Fig. 25



Unscrew delivery valve holders and store together with valve springs if fitted. (In the case of ball-type delivery valves, there are no valve springs).
Withdraw delivery valves with valve lifter 0 681 340 009 – EF 8117 A and store. Fig. 26

25 On PES..KL../.. unscrew barrel locating screws.
Position pump horizontally and with auxiliary tool (made to sketch 1, Page 30) introduced through control sleeve, push pump barrel out in upward direction.
On PES..KL../.. and PES..KL..A.. remove O-rings from plunger and barrel seats in housing. Fig. 27

26



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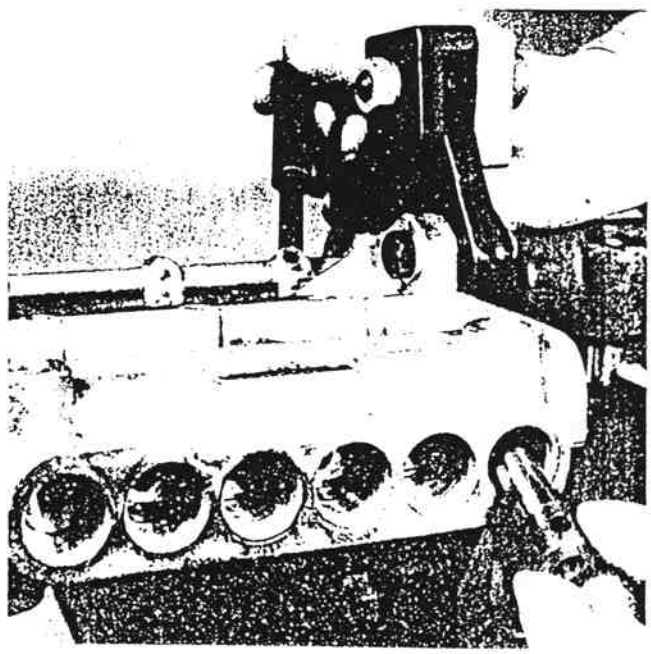
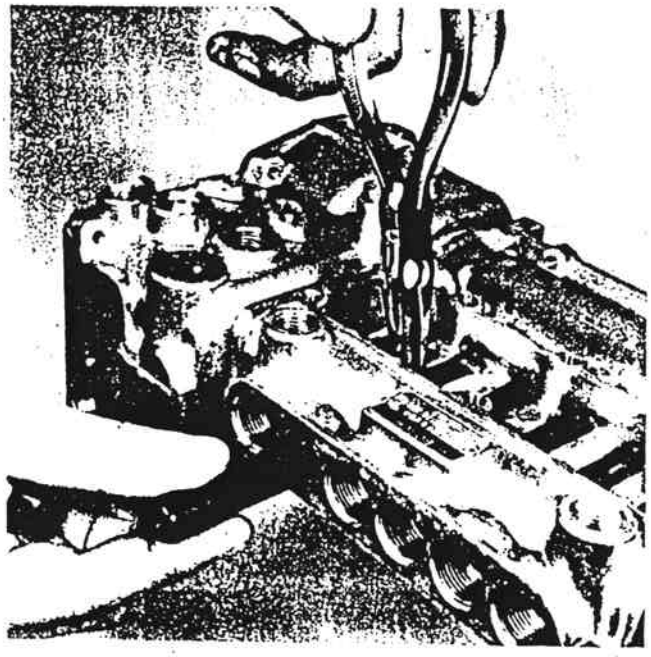
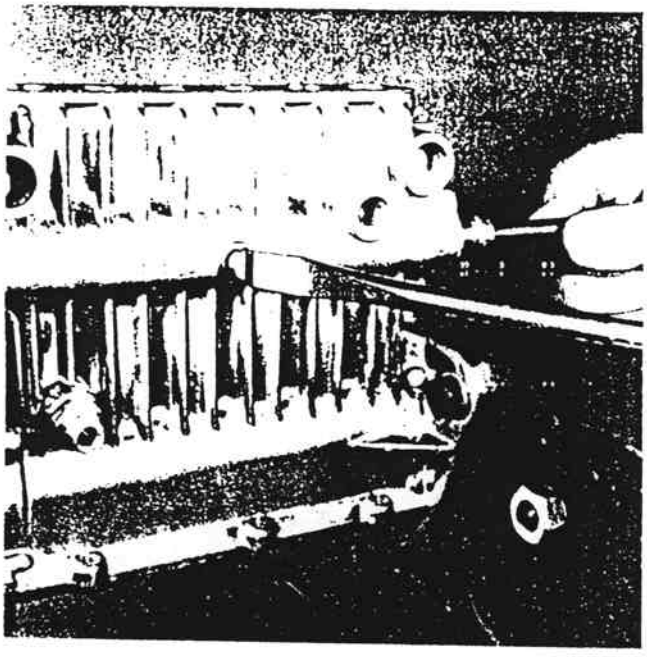




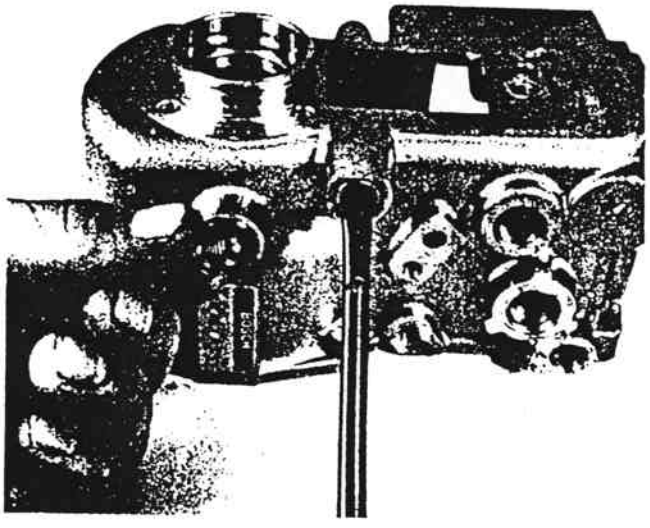
28

Hold gear segment with a pair of thin-nose pliers and press control sleeve out of gear segment from the top using auxiliary tool (sketch 2, Page 30). Remove control sleeve with upper spring retainer in downward direction and gear segment towards the front, storing these components in correct sequence.



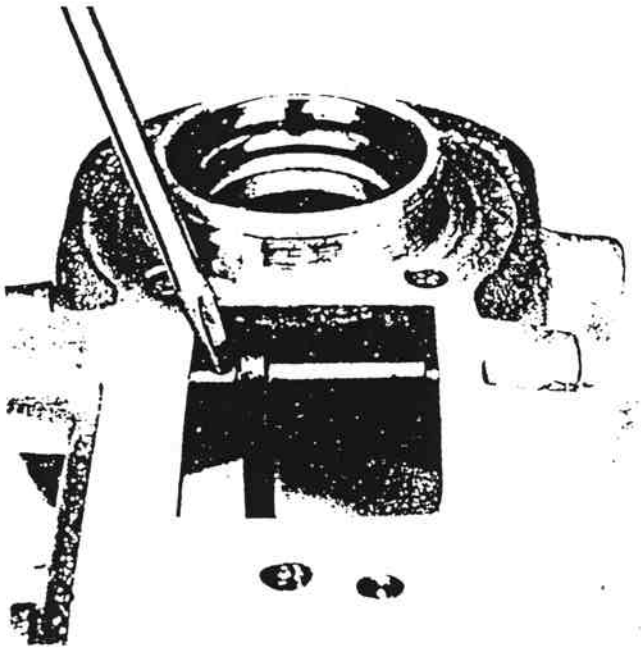
29

On PES..KL.. unscrew control rod locating screw and withdraw rod.
The double in-line pump has no rod locating screw. Draw rod out of guide from governor end.



30

Remove governor housing:
Unscrew governor housing fastening screws, and release the governor housing from the register in the pump housing by light blows with a rubber hammer (do not tilt).
Remove roller lever from governor housing:
Remove screw plug from adjusting screw bore and tighten the adjusting screw fully using a screwdriver.

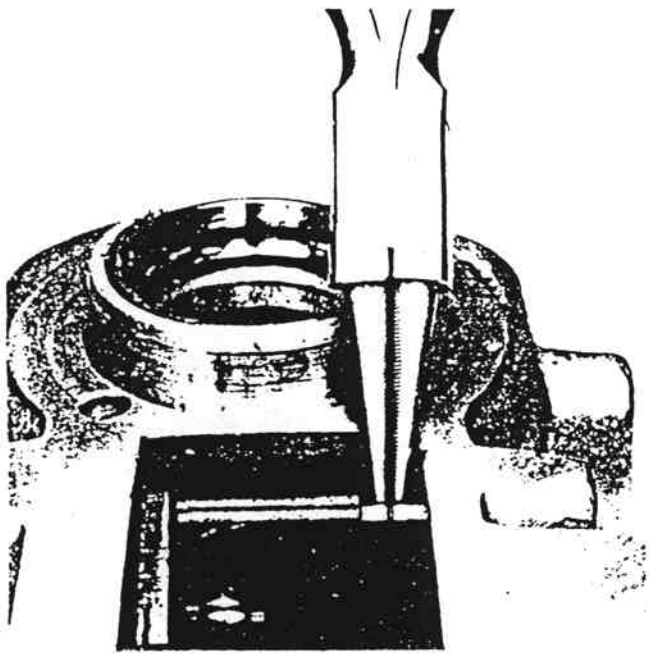


31

With a small screwdriver remove retainer at the side of the roller lever. Fig. 31

Push roller lever to one side and remove second retainer with thin-nose pliers. Fig. 32

Unscrew adjusting screw.
Withdraw lever shaft together with spring through the adjusting screw aperture (note thrust washers) and remove roller lever. Fig. 33



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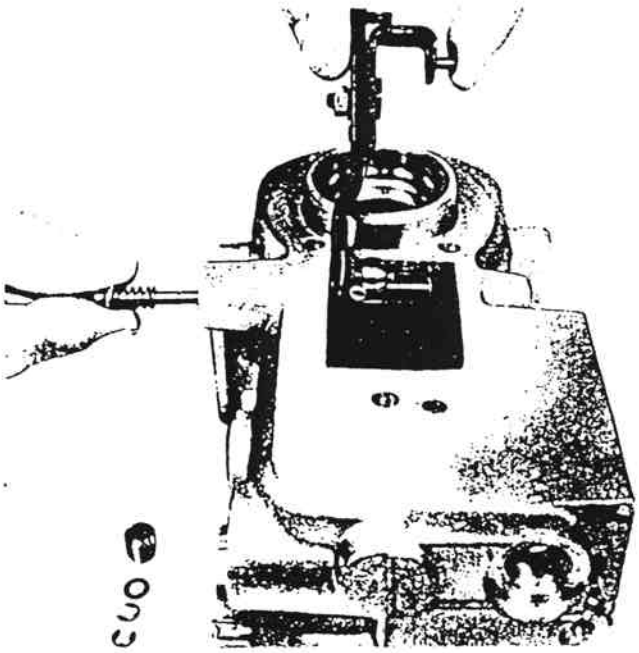

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3. Inspection and repair

Thoroughly clean all component parts of pump and governor, check for damage and wear. Information concerning the testing and assessment of injection pump component parts appears in Repair Instructions VDT-WJP 101/1 B, Section IV, as appropriate.
The plunger and barrel seats in the pump housing should be carefully smoothed if necessary using the hand milling cutters listed below:

PES..KL../.. = Hand milling cutter 1 687 910 003 – EF 8488 B

PES..KL..A.. = Hand milling cutter 1 687 910 006 – EF 8488 E.

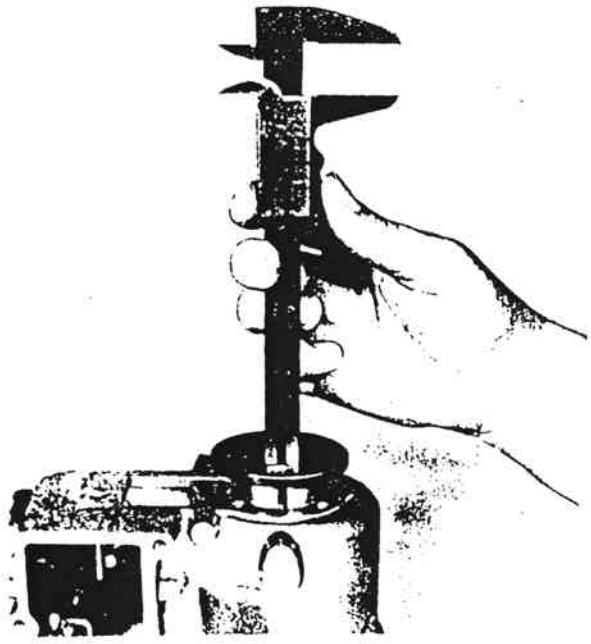
PES..KL..B.. = but spigot of 1 687 910 008 –

PED..KL.. = EF 8488 G (dia. 12mm- 15/64 in)

When smoothing, apply slight pressure only and make sure that the hand milling cutter is not tilted.
As far as the governor is concerned, it is essential to ensure that all component parts and bearings of both governor and correction unit have not suffered any wear; these parts must be renewed even when slightly worn.
The cam should be renewed if the bonderized surface layer has been damaged or shows roller tracking.
The control valve for the auxiliary idling air must move easily and must not show any seized zones. For adjusting the control valve and checking the temperature sensor, see Test Instructions VDT-WPP 711/1 B.
The air thermostat cannot be tested and should be renewed in case of doubt.
For testing the altitude compensator, see Test Instructions VDT-WPP 711/1 B. The air filter on the control valve can be checked for contamination by blowing through. Should this filter have been in use for some time, it should always be renewed.
The air filter on the top of the governor (no longer exists as from "B" pump modification) must also be renewed if it has been in service for some time.
When reassembling, always use new O-rings and seals.
It is essential to ensure when fitting new components that these are always the correct components for the given type of pump and governor as shown in the service parts lists.
All moving parts should be dipped in test oil prior to reassembly.

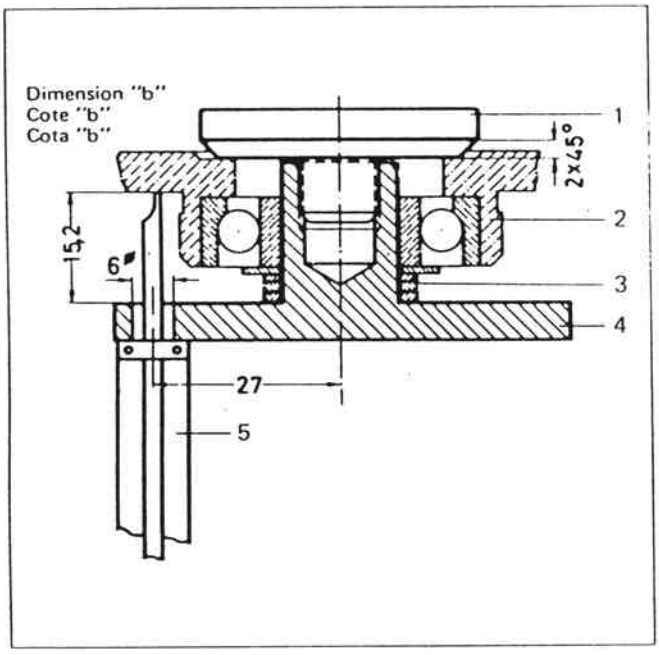
4. Assembly

4.1 Assembling the injection pump



34

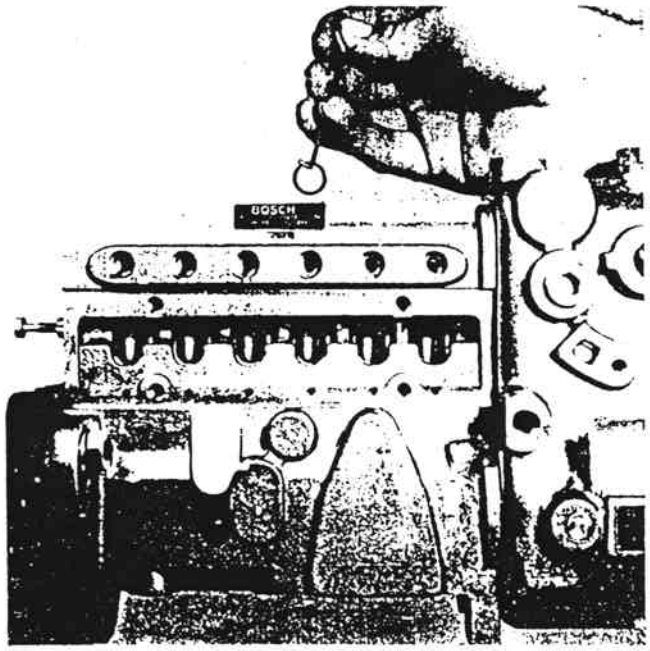
Measure bearing assembly dimension "b" (in accordance with test specification sheet). For this purpose withdraw inner ball race from camshaft and insert together with ball cage into the outer race in the governor housing. Insert measuring plate of measuring device 1 688 130 025 – EFEP 413, tighten with knurled screw from the other end.
Using a depth gauge inserted into the hole in the measuring plate, measure dimension "b" i.e. the distance from the top surface of the measuring plate to the governor housing minus the thickness of the plate.



35

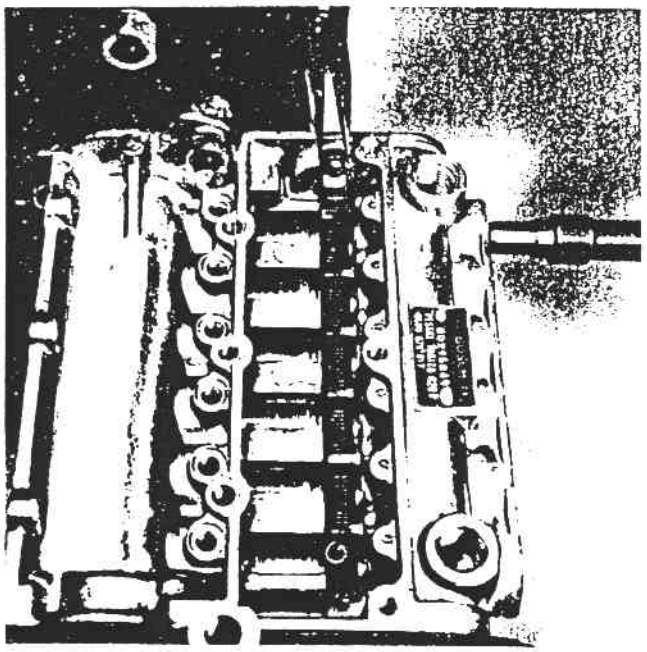
Dimension "b" is adjusted correctly by inserting spacing washers of appropriate thickness between measuring plate and inner ball race – washers as shown in the service parts list.
Having established the requisite number of spacing washers, press inner ball race onto camshaft.
The measuring device 1 688 130 025 – EFEP 413 was formerly supplied without bore (6 mm / 15/64 in dia.) in the measuring plate and without a chamfer on the knurled screw. If necessary, this modification can be carried out subsequently in accordance with sketch – Fig. 35.

1 = Knurled screw
2 = Governor housing
3 = Spacing washers
4 = Measuring plate
5 = Depth gauge (vernier)



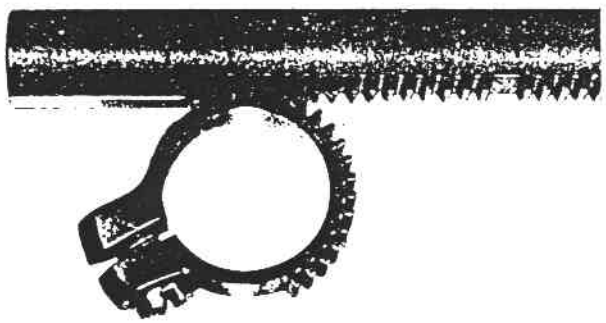
36

Refit governor housing. Do not forget or damage gasket when fitting.
Caution: Contrary to the information appearing in the service parts list no spring washer must be used under the upper fixing screw of the governor housing.
Fit control rod such that its geared or threaded end points towards the governor.
On PES..KL..: screw locating screw for control rod into position.
On PED..KL..: place washer and retainer on control rod (only on rods with teeth on face). When fitting the control rod, it is essential to ensure that the offset of the gear segments corresponds with the offset for the plunger and barrel assemblies in the pump housing.
On PES..KL../.., PES..KL..A.. (pumps with oil block) insert O-ring for pump barrels into seat in pump housing. To avoid damage (shearing) the O-ring must not be pushed onto the pump barrel and then fitted together with the barrel.
On PES..KL.., PED..KL.. this O-ring is not fitted (pumps without oil block).



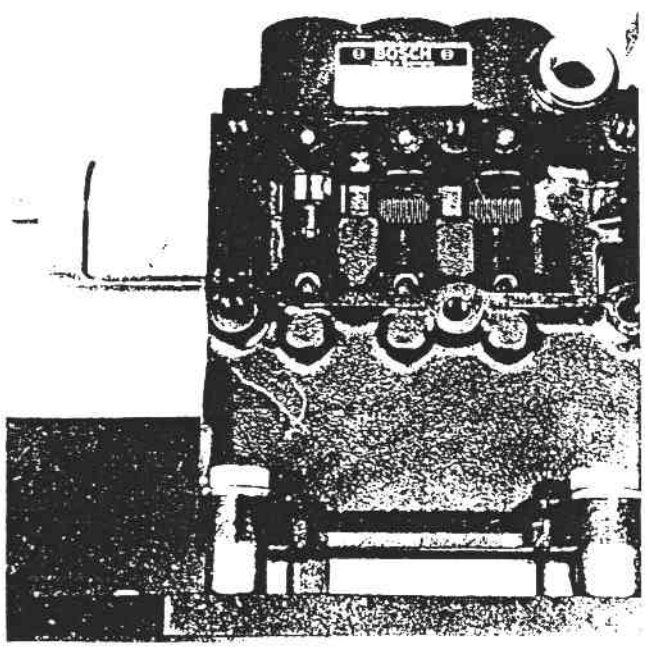
37

Position pump horizontally.
Insert control sleeve gear segment from the front (see Fig. 38). Simultaneously insert pump barrels with auxiliary tool from above (sketch 3 or 4, Page 30).
On pumps with oil block, coat pump barrel with tallow to ensure that the O-ring is neither sheared nor damaged when the barrel is inserted.
On PES..KL../.. make sure that the oval locating bore on the large shoulder of the pump barrel is aligned with the bore for the barrel locating screw. Immediately after fitting the pump barrel, screw locating screw into position complete with sealing washer but do not tighten at this stage.
On PES..KL..A.., PES..KL..B.., PED..KL, insert pump barrels in such a way that the locating groove comes into engagement with the locating pin in the housing (or with locating screw in the case of PES..KL..A..). After fitting a gear segment and pump cylinder, immediately also fit the appropriate control sleeve (see Fig. 42).



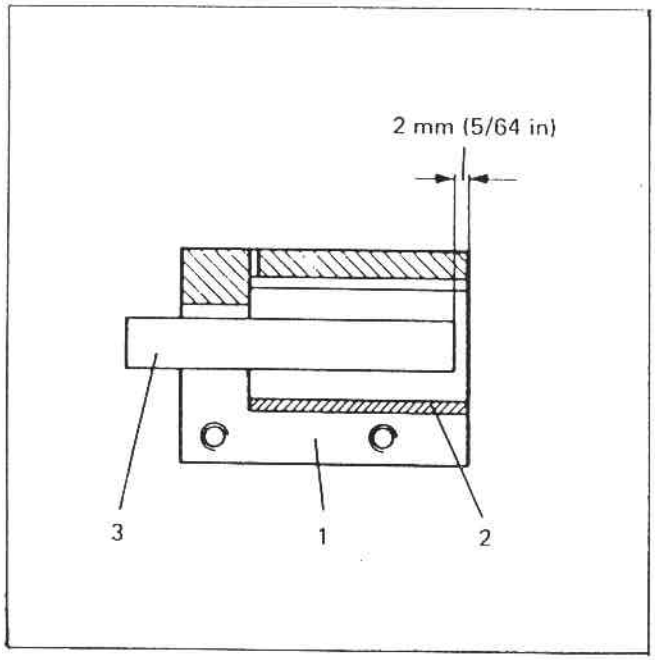
38

On PES..KL.. fit control sleeve gear segment in such a way that the head of the clamping screw points towards the pump face 2 (governor end) and also so that in the control rod stop position the second tooth of the gear segment is in the first gap in the control rod (the illustration shows the correct position in disassembled state for greater clarity). Do not move pump so that the gear segment cannot come out of engagement.



39

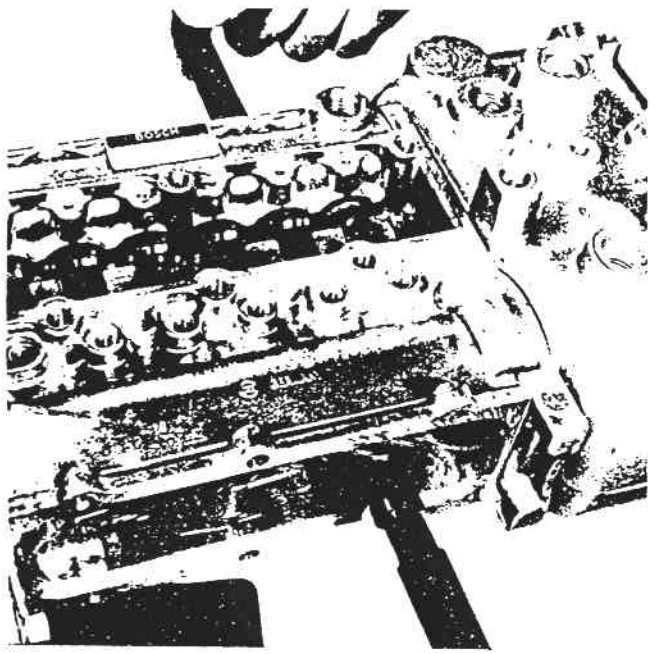
On PED..KL.. fit control sleeve gear segment with control rod in center position. Adjustment and location of the control rod is then carried out with the aid of dial indicator holder 1 680 390 003 – EFEP 255 (test tool) in conjunction with a clamping sleeve and pin (sketch 5, Page 30). For utilization and adjustment of clamping sleeve, see Fig. 40.
In the case of the R.H. bank of elements, the heads of the gear segment clamping screws point towards the governor and in the case of the L.H. bank of elements towards the drive end. After fitting the gear segments, pump barrels and control sleeves of one bank of elements, pull control rod to "stop" so that the gear segments cannot come out of engagement. Now swivel pump towards other side so that the barrels cannot fall out.



40

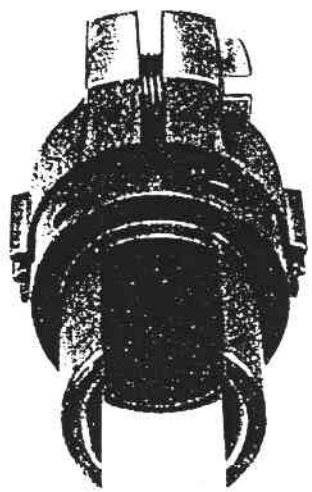
Insert clamping sleeve into large bore of dial indicator holder. Insert stop pin into small bore of dial indicator holder, set distance of 2 mm (5/64 in) as shown and lock the pin.
Place complete assembly on projecting clamping sleeve of control rod guide bushing on drive side until in contact with the stop face and clamp in position.
Push control rod from rod end against stop pin.

1 = Dial indicator holder
2 = Clamping sleeve
3 = Stop pin.



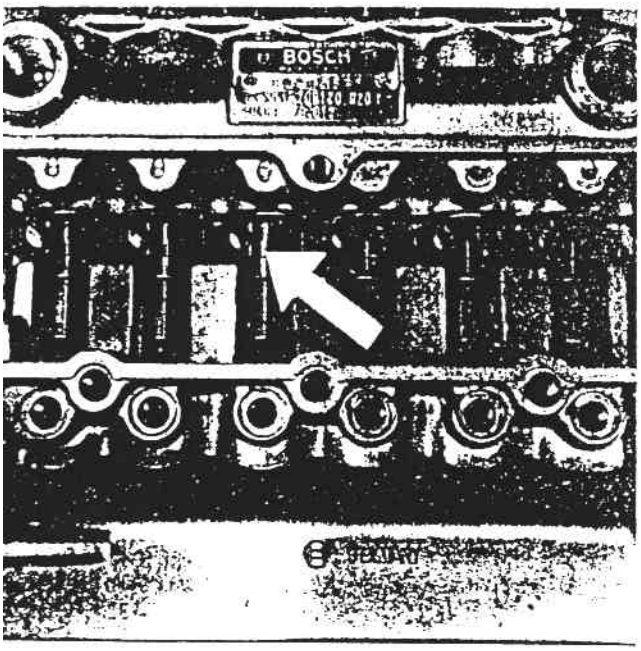
41

Hold pump barrels from above with auxiliary tool, sketch 3, and push guide sleeve from below onto pump barrel and into gear segment using auxiliary tool (sketch 4, Page 30).



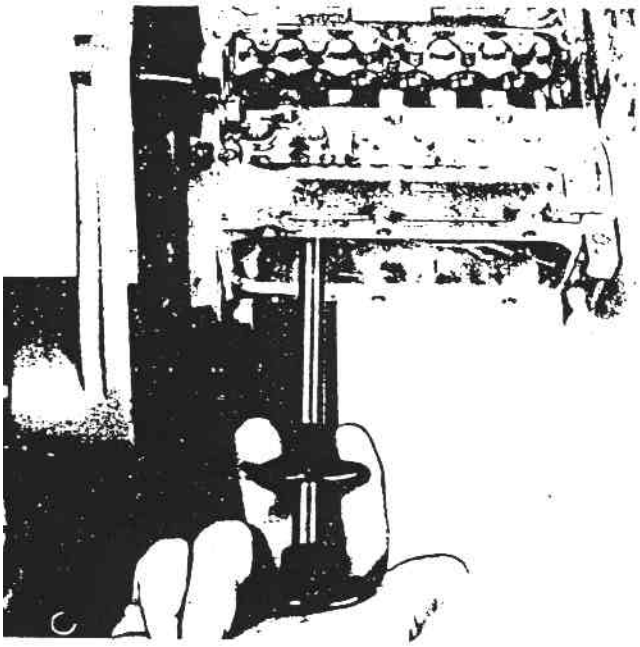
42

In the assembled state, the holes in the large shoulder of the control sleeve must be at the front, i.e. on the same side as the clamping slot in the gear segment.



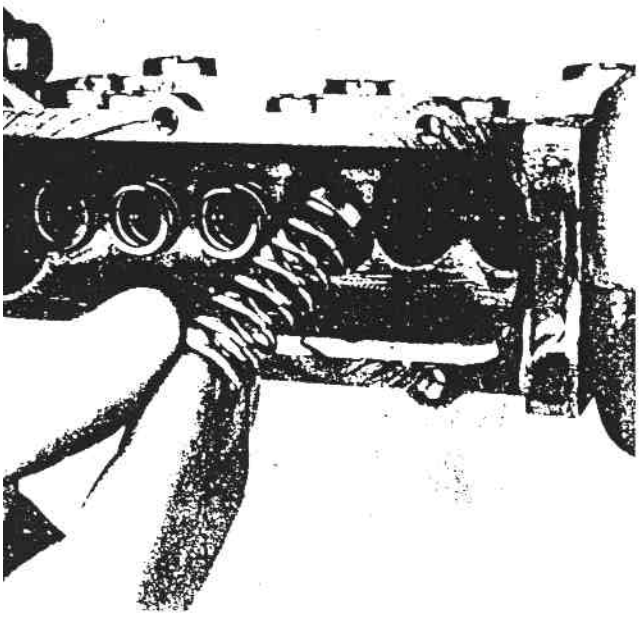
43

Lightly tighten the gear segment clamping screws. If gear segments and control sleeves were marked before disassembly, align these markings once more.
Ascertain whether the total travel of the control rod is in fact available. Total control rod travel on
PES..KL.. = 18.0 – 18.5 mm (45/64 – 47/64 in)
PED..KL.. = 17.2 – 18.4 mm (43/64 – 23/32 in) (control rod with retainer).
PED..KL.. = 19.0 – 20.0 mm (3/4 – 25/32 in) (control rod without retainer).



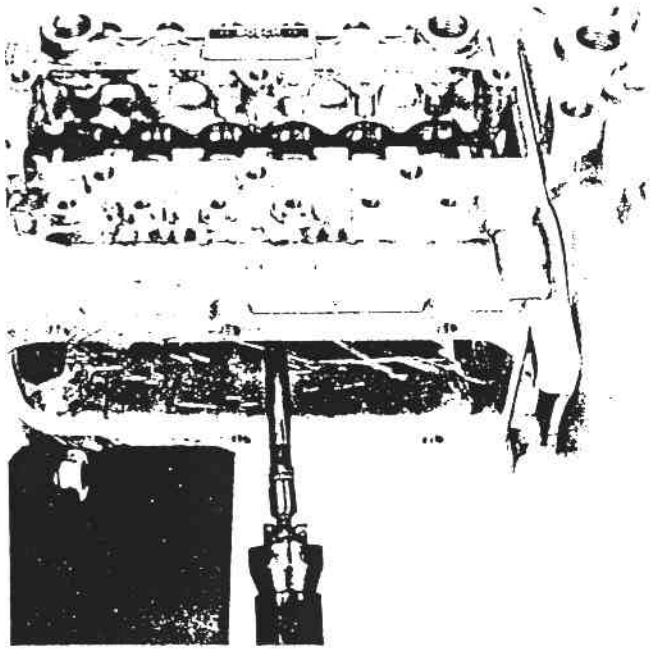
44

Set control rod to "stop" to ensure that gear segments and guide sleeves cannot come out of engagement. Position pump vertically.
Insert delivery valves with sealing washers.
Screw delivery valve holders into position and tighten with torque wrench using the following sequence:
Tighten to 4 kgf.m, release, tighten to 4 kgf.m, release, tighten finally to 3.5 ± 0.5 kgf.m. (For tightening torques, see also Page 31.)
On PES..KL../.. tighten barrel locating screws finally. Pump plungers without plunger base spring and spring retainer should be introduced into the appropriate barrels with the aid of plunger gripper 0 681 340 002 – EFEP 76 and the plungers should then be checked for free movement. Causes of stiff plunger movement are excessively tightened delivery valve holders or poor pump barrel seating in the pump housing. Store pump plungers once more in correct sequence.



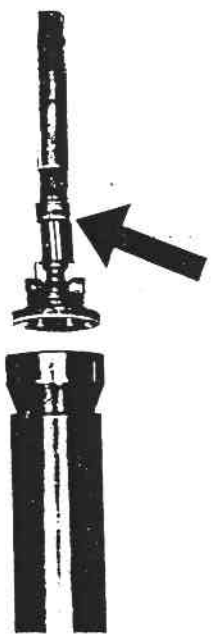
45

Insert tappet spring with top spring seat.



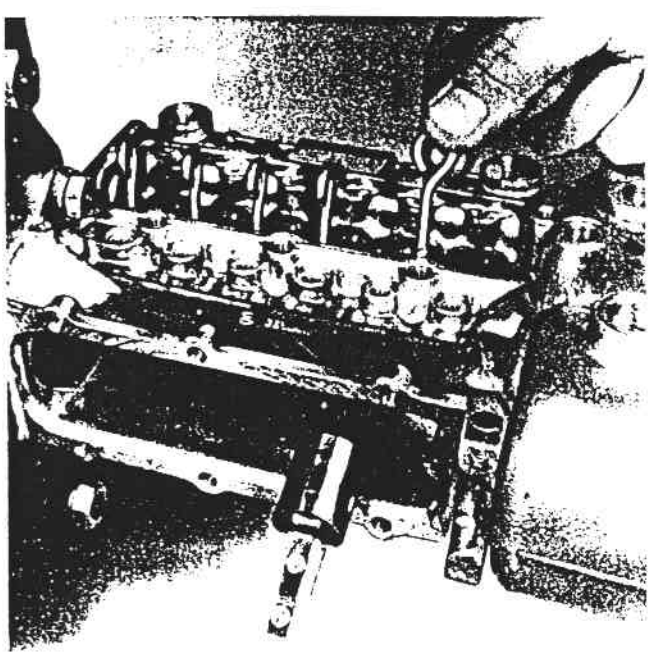
46

Fit pump plungers.
Push plunger base spring onto plunger base. Engage plunger base in bottom spring seat. Insert eye of spring into hole in spring seat (note special instructions, Fig. 47).
Insert spring seat into spring seat gripper 1 688 110 030 – EFEP 457 in such a way that the two pegs engage with the recess in the gripper – marked on the outside by a ground face. With the aid of the spring seat gripper, the pump plunger together with plunger base spring and spring seat can now be inserted into the appropriate pump barrel.
Dip pump plunger in test oil beforehand. Do not tilt when inserting and do not use force.



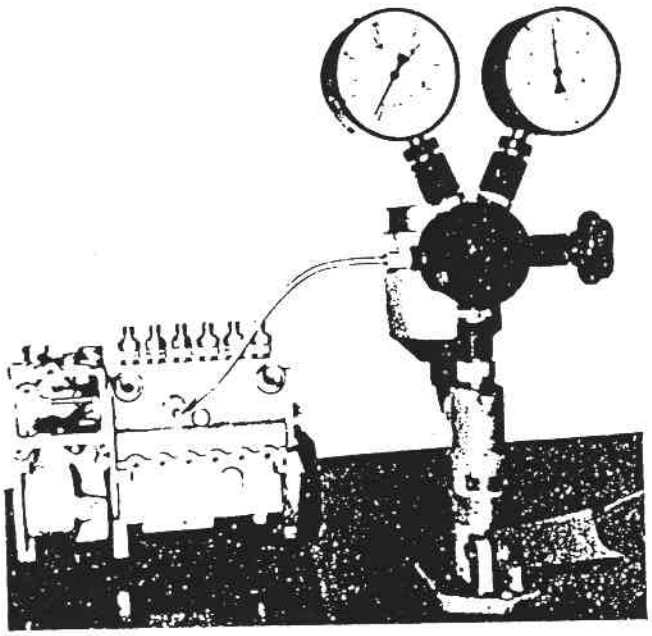
47

The following instructions should be given special attention when fitting pump plungers:
On PES..KL..120..: left-hand helix. Left-hand plunger base spring. The plunger base spring is brought into engagement over the plunger vane on the side with a notch marking.
Fit plunger so that the notch marking on the plunger vane is at the front of the pump.
On PED..KL..120.., **R.H. bank of elements:** left hand helix. Left-hand plunger base spring. The plunger base spring is attached over the plunger vane on the side showing the three-digit number.
Left-hand bank of elements: Right-hand helix, right-hand plunger base spring (marked with red paint). The plunger base spring is attached on the side showing the three-digit number. Fit plungers on right-hand and left-hand bank of elements so that the three-digit number on the plunger vane is always visible on the outside of the pump. For explanation of markings on plunger vane, see VDT-WJP 011/3 B.



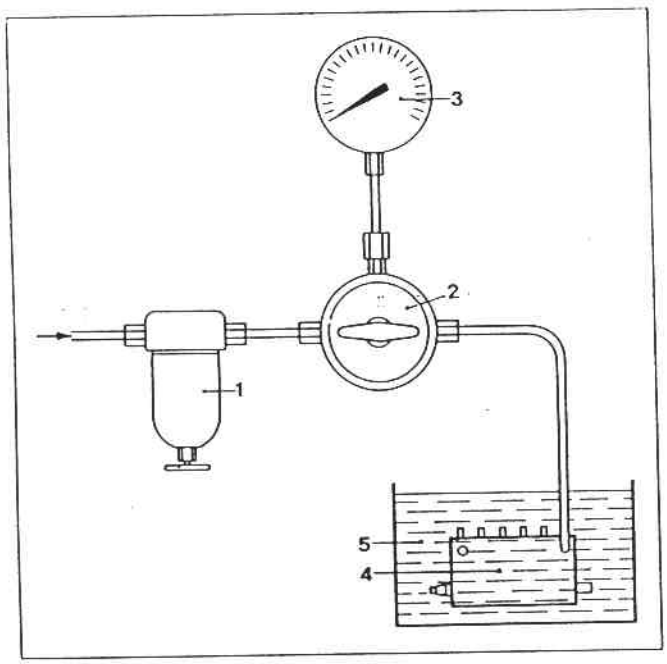
48

Having fitted a pump plunger, immediately also fit appropriate roller tappet:
Grasp roller tappet with tappet clamp 1 683 083 000 – EF 8184 B and insert in such a way that the guide groove is correctly positioned in relation to the locating screw in the pump housing.
On PED..KL.. ensure that the inclined face on the underface of the tappet is on the inside (towards pump centerline).
When pushing the tappet up, rotate tappet to and fro slightly until the two pegs of the bottom spring seat engage audibly in the roller guide. If the pegs fail to engage, the spring seat is seating obliquely which causes plunger and control rod binding. Hold roller tappet in its "up" position using suitable tappet holder (see text, Fig. 18).



49

On PES..KL../.., PES..KL..A.. check oil block for leaks. Remove pump from clamping bracket and connect oil block to nozzle tester using intermediate adaptor.
A pressure drop from 15 to 10 kgf/cm² (213-142 psi) must take at least 30 seconds.



50

Check suction cavity for leaks. For this purpose connect compressed air line to fuel inlet of pump. Close off the return connection. Close off the oil-block (where provided).
Close outlets of delivery valve holders (possibly with cap nuts for delivery pipes an; balls). Check pump under 3 kgf/cm² (42.7 psi) pressure in oil bath. A few air bubbles may exude but only from the pump plunger shank.

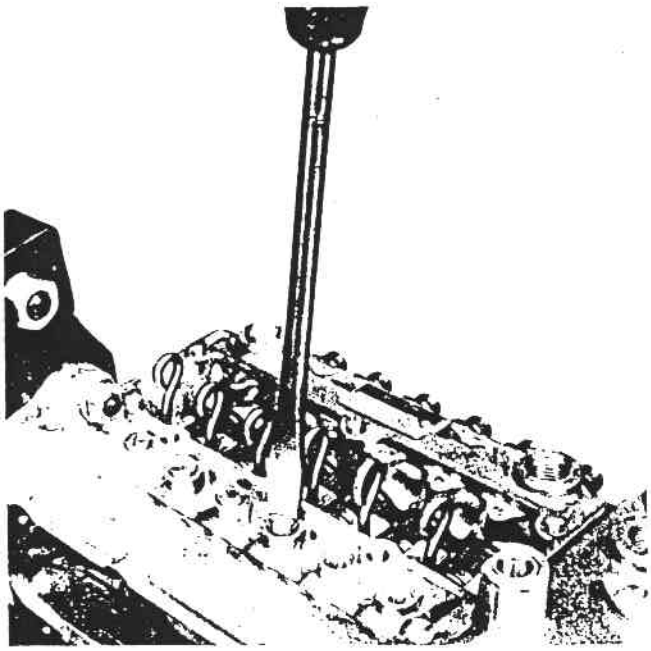
1 = Water separator
2 = Pressure regulator
3 = Pressure gauge
4 = Injection pump
5 = Oil bath

51

Tension plunger base springs.
With tappet clamp 1 687 953 011 – EFEP 458 hold roller tappet in its "up" position. Withdraw tappet holder. Rotate tappet clamp and roller tappet through 360°. Refit tappet holder.
Direction of rotation:

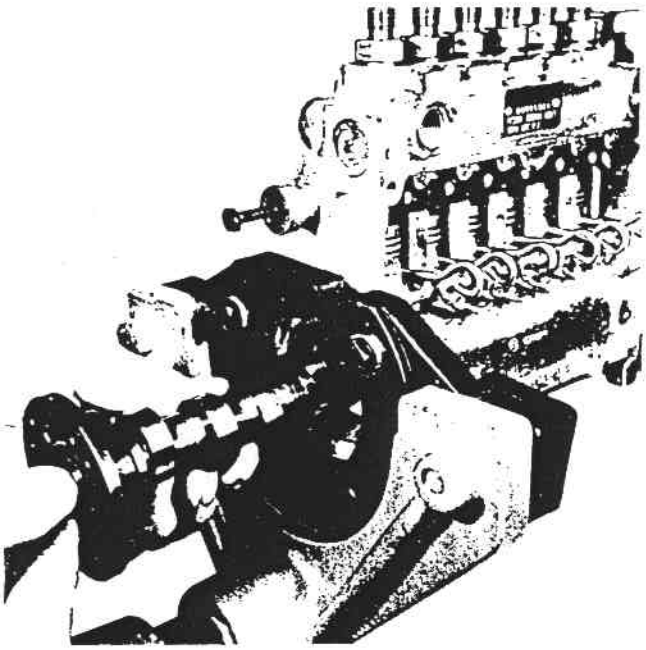
On PES..KL..120.. clockwise.
On PED..KL..120.., right-hand bank of elements clockwise, left-hand bank of elements counterclockwise.

With pump positioned vertically, the control rod should move so easily that the tensioned plunger base springs pull the control rod from "stop" to "maximum delivery".



52

On PED..KL.. screw roller tappet locating screws into position and tighten.

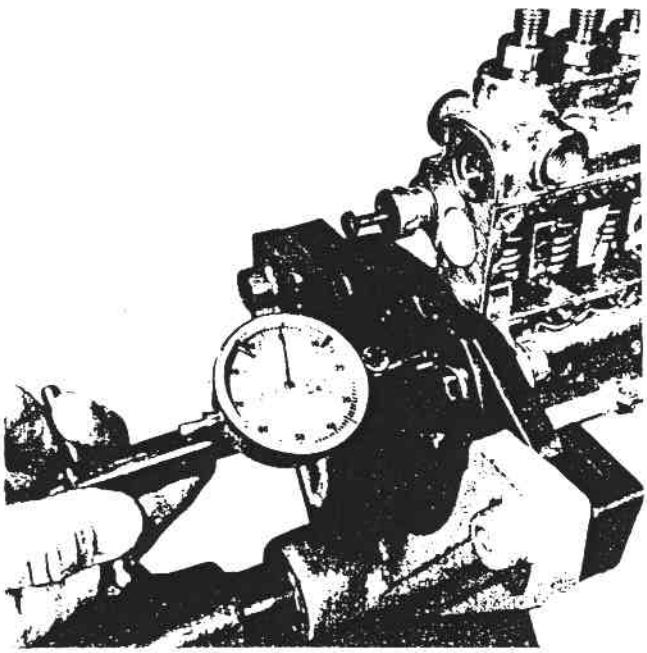


53

Fit camshaft.

Press inner race of single row angular contact ball bearing or single row radial ball bearing (see service parts list) onto camshaft (for general hints, see also Repair Instructions VDT-WJP 101/1 B). Screw mounting sleeve 1 680 390 004 – EFEP 294 (to protect shaft seal) on camshaft taper. Place drive side bearing cover on ball bearing (in the case of single row angular contact ball bearings with pressed-in outer race). Introduce camshaft together with bearing cover and screw bearing cover into position.

Note position of scribe mark on bearing end plate. In the case of clockwise-rotating pumps this mark should be approximately at 45° top left, in the case of counter-clockwise-rotating pumps approximately 45° top right.

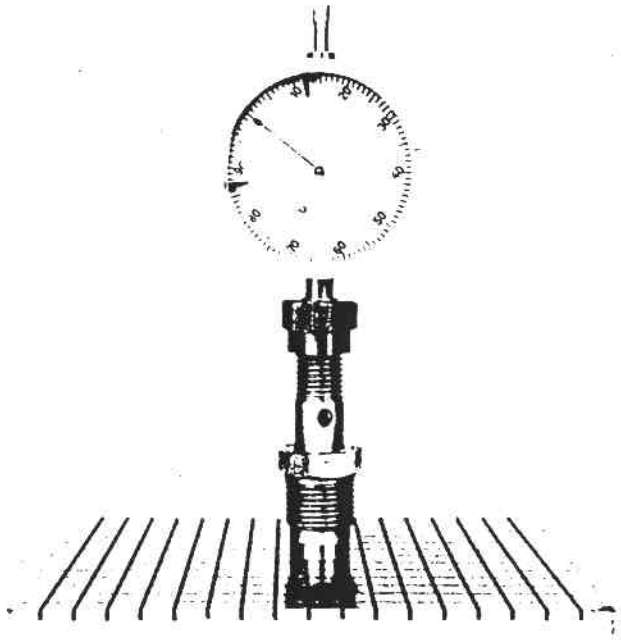


54

Check end play of camshaft when shaft is not under load: Screw measuring device 0 681 440 011 – EFEP 225 to camshaft taper. Clamp dial indicator 1 687 233 001 – EFAW 7 into device and preload slightly.

Exert an accurate straight-line pull on camshaft together with measuring device at the same time rotating slightly in both directions. Set dial indicator to "0" while pulling. Subsequently, exert pressure on camshaft under identical conditions and read dial indicator at the same point on the bearing end plate. The end play should be 0.05 – 0.01 mm (0.00197 – 0.00394 in).

If necessary, replace spacing washers but only on ball bearing on drive side of camshaft.



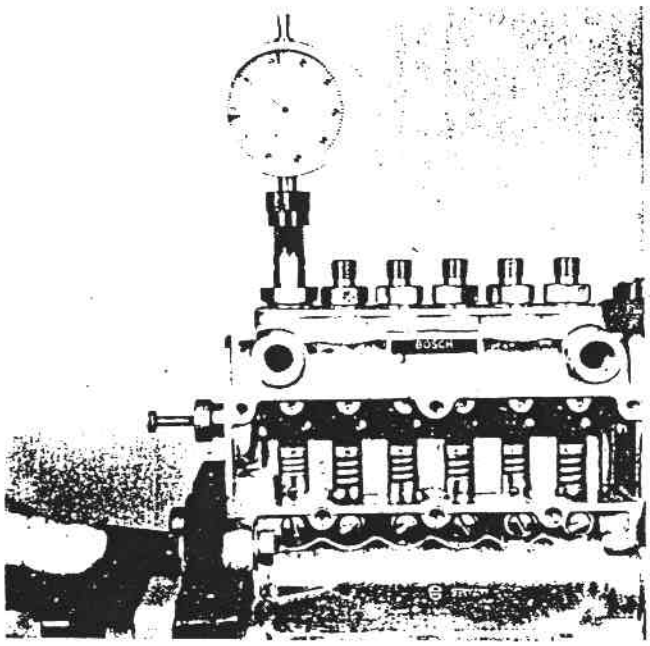
55

By rotating the camshaft, bring the individual roller tappets into their T.D.C. position. Relieve tappet holder and remove.

Check plunger backlash at T.D.C. using measuring device 0 681 440 014 – EFEP 254 and dial indicator 1 678 233 011 – EFAW 7:

Insert dial indicator with long measuring stylus (approximately 45 mm/1.772 in long) into measuring device. Place measuring device on a flat surface and set dial indicator with approx. 5 mm (0.1969 in) preload to any arbitrary value. Note this value down.

For PES..KL..A.., PES..KL..B.., PED..KL.. an intermediate adaptor is required to extend the measuring device (made according to sketch 6, Page 30).



56

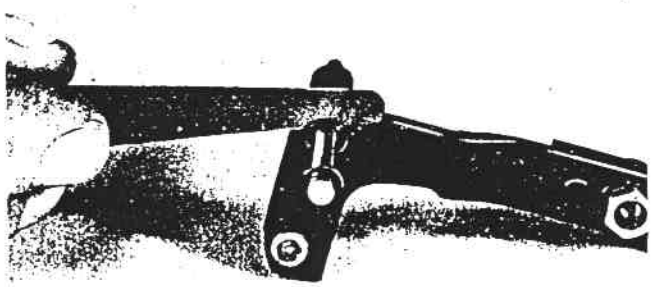
Remove delivery valve holder and delivery valve with sealing washer. Screw preset measuring device (possibly with intermediate adaptor, see text Fig. 55) into position and tighten slightly. Rotate camshaft until plunger is at T.D.C. The difference between the value now shown and the value previously set on the dial indicator as described in Fig. 55 is the plunger backlash at T.D.C.

Correct plunger backlash:

PES..KL../..	0.7...0.9 mm (0.0276 – 0.0354 in)
PES..KL..A.., PES..KL..B..	
PED..KL..	0.5...0.6 mm (0.0197 – 0.0236 in)

If necessary, readjust by exchanging the rollers in the roller tappets (see service parts list).

It is advisable to measure all barrels consecutively, to note any deviating dimensions and to exchange any incorrect rollers at the same time.

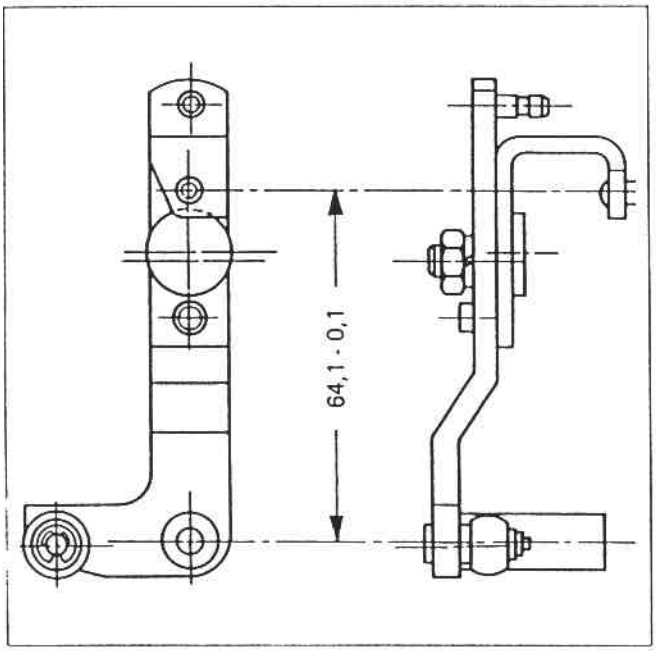


57

Measure and adjust roller lever:

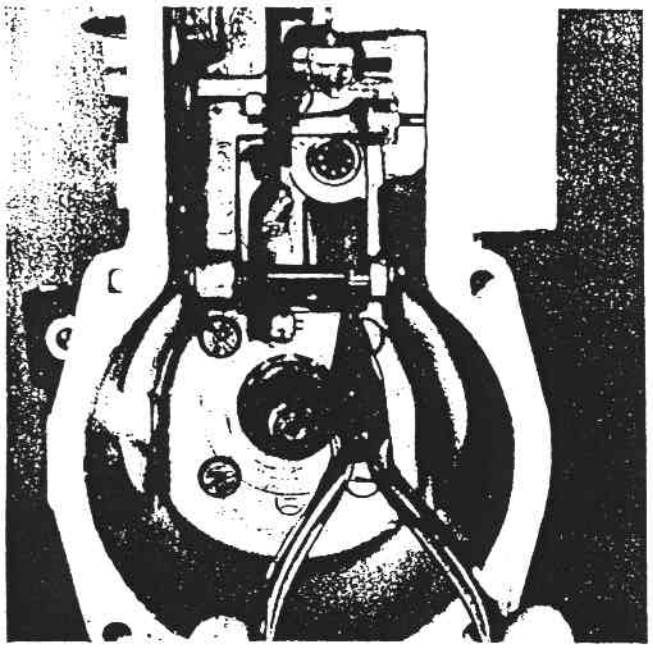
Place disassembled roller lever onto shaft and secure both retaining rings. Check end play with feeler gauge and adjust with spacing washers to a maximum of 0.05 mm (0.00197 in).

Side play in the follower roller should be adjusted by using spacing washers between follower roller and retainer to a maximum of 0.05 mm (0.00197 in).



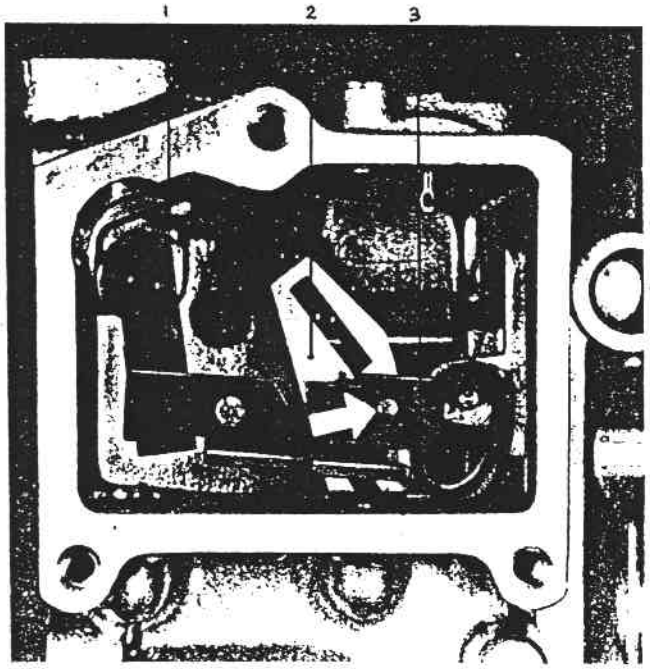
58

Inspect control dimension of roller lever (64.1–0.1mm / 2.5-0.00394 in). While making this check, the bell crank lever is parallel to the roller lever. Correct by bending the bell crank lever, or if necessary, renew roller lever.
Remove retainers and take roller lever from shaft.



59

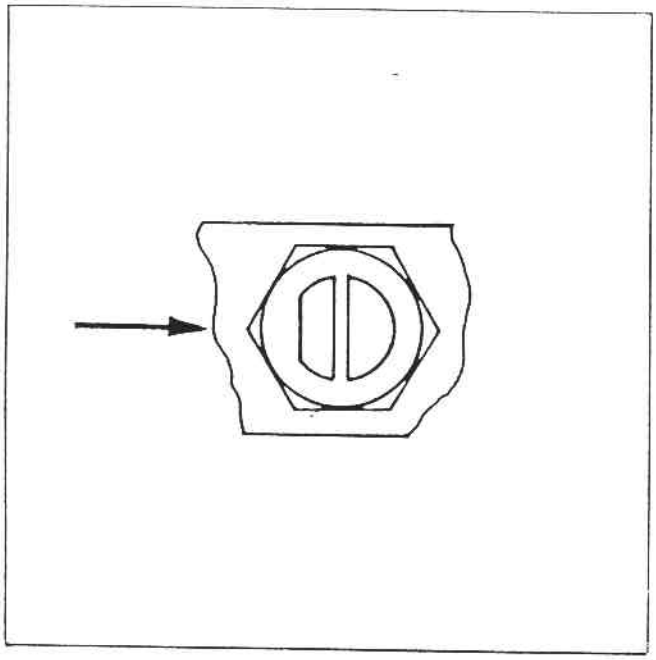
Fitting the roller lever:
Introduce shaft with outer retainer, washer and spring into governor housing, then insert the roller lever. Screw set screw into governor housing and insert retainer on both sides of the roller lever.
Back out the set screw until the roller lever is fully to the left.



60

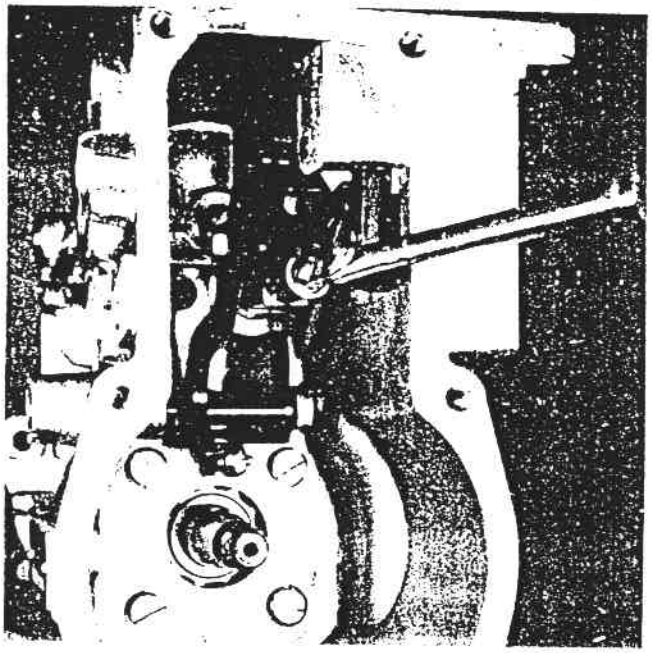
4.2 Fitting the compensating unit

Fit correction lever with transfer and swivel levers. Fit retainer for swivel lever.
On PES..KL../.. engage tension spring.
1 = Swivel lever
2 = Transfer lever
3 = Correction lever



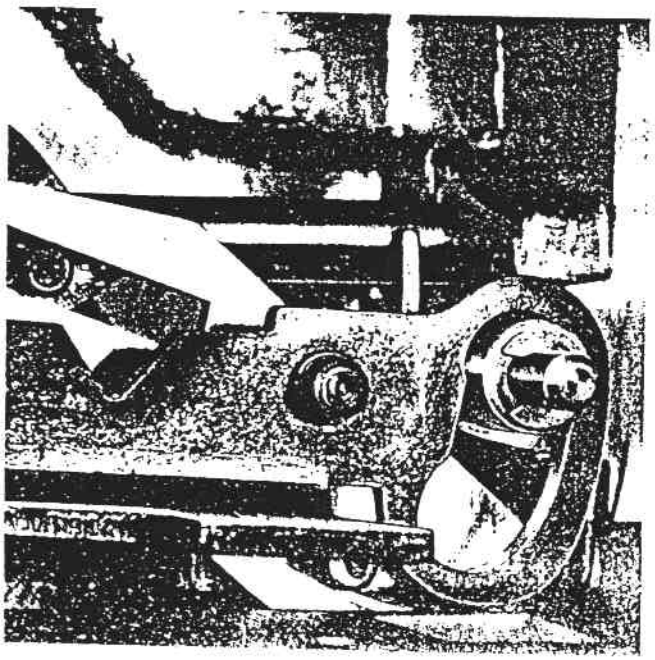
61

A number of different compensating units incorporate a correction lever with adjustable bearing for the transfer lever (adjusting eccentric, see arrow, Fig. 60).
Preset the eccentric in such a way that the marking (flat on threaded stud) points towards the swivel lever.



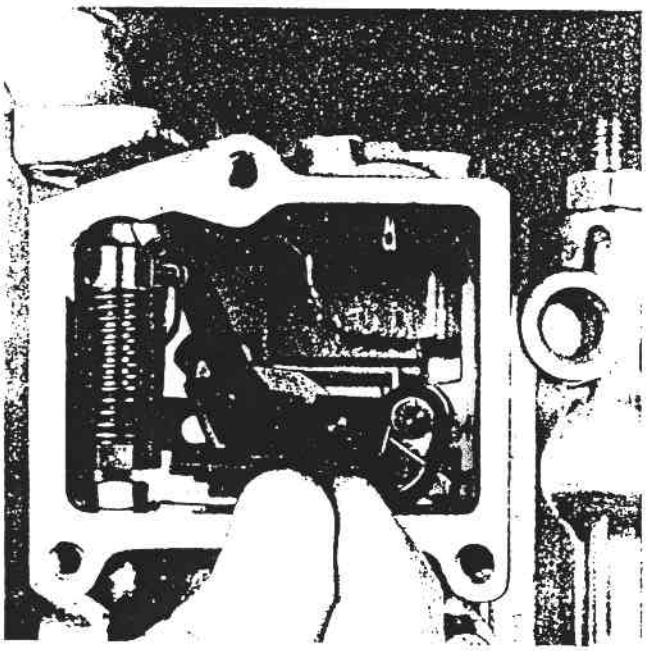
62

Screw in the control rod head.
In the case of earlier designs, ensure correct position of ratchet washer.
On the new design, do not forget the small spring plunger locating the adjusting nut.
The guide pin at the side must engage in the lower slot of the transfer lever on the correction lever. The guide tongue is guided by the bolt in the governor housing above the control rod.
By screwing in the set screw bring follower roller of roller lever approximately to the center of the camshaft. The guide pin of the roller lever must engage in the upper slot of the transfer lever on the correction lever.



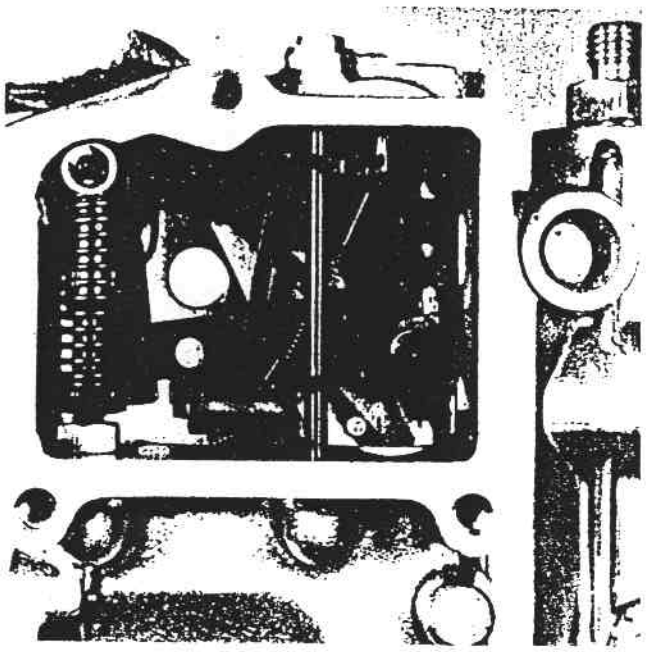
63

Fit guide roller of correction lever and lock in position with retainer.



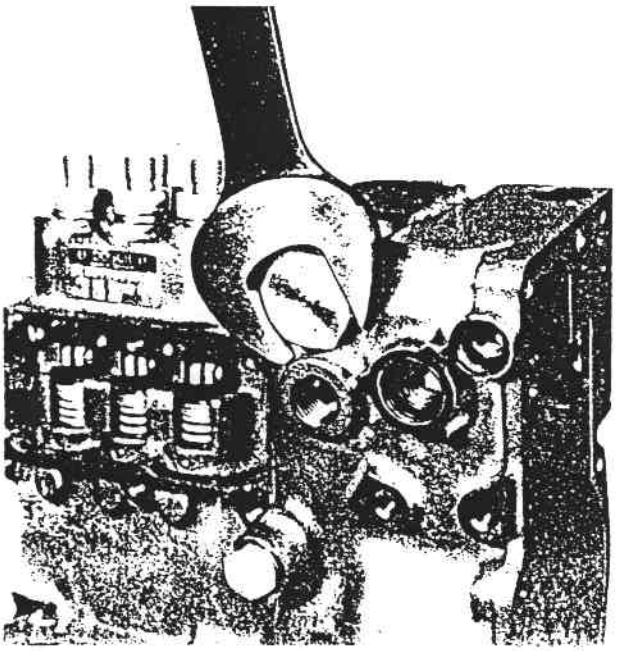
64

Screw in guide pin of guide assembly together with any spacing washer and lock nut. Slightly tighten the lock nut.
Where fitted, insert spring seat (see service parts list), spring and guide part.
Push lever guide downwards and fit rocker. Secure washer and retainer to rocker bearing pin.



65

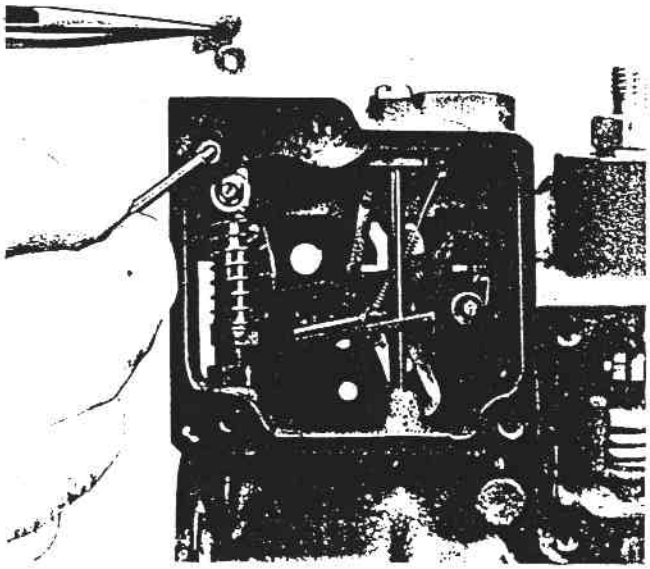
Insert guide pin – with turned shoulder (where existing) downwards – and close guide bore with locking screw. Engage tension soring.
Insert link fork between correction lever and rocker.
(In the case of link fork with chamfer, the chamfer points towards the drive end).



66

In the case of governors with altitude compensator on control lever side, screw in transfer shaft with screw plug. The transfer shaft makes contact with the rocker within the compensating unit.

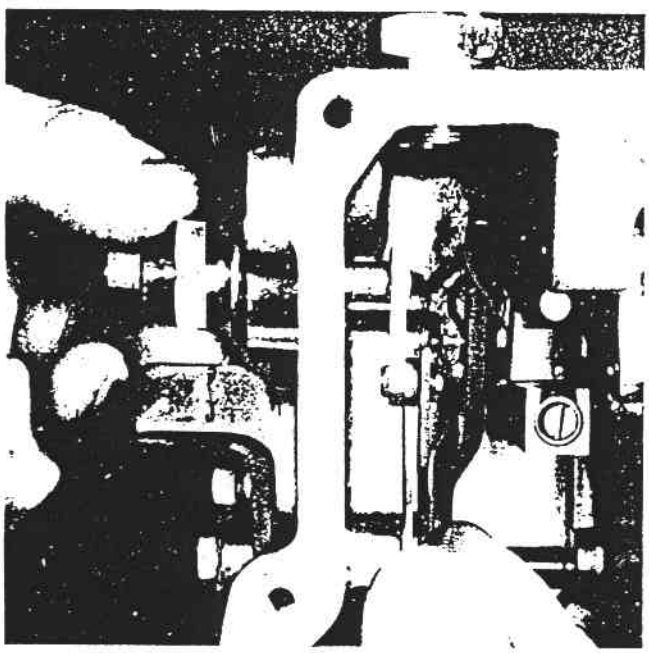
In the case of governors with air thermostat on the governor cover, fit angle bracket from above in such a way that the wider side (larger radius) is in contact with the guide part.
Simultaneously introduce bearing pin for angle bracket – with turned shoulder leading.



67

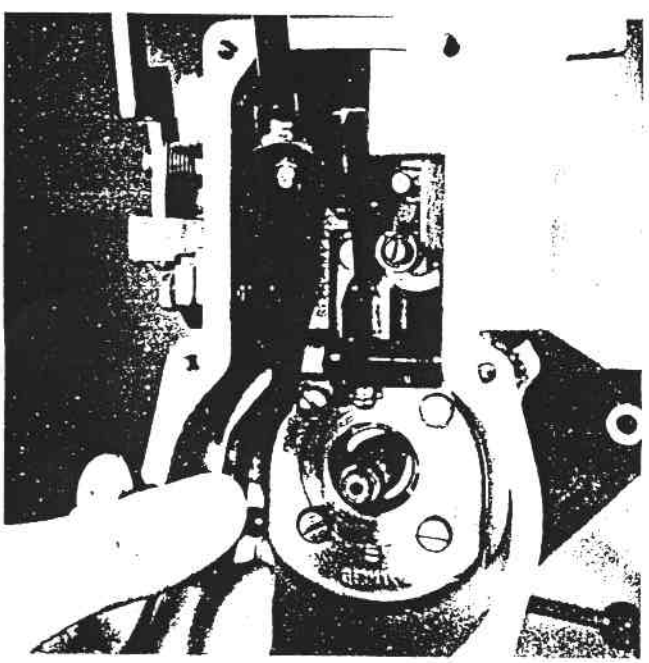
4.3 Fitting the governor

Screw stop plate for control lever into position.
Fit control lever:
On governors of the older design insert lever spindle with riveted-on cam adjusting lever from inside into the bore of the hollow screw (bearing bushing). Insert hollow screw complete with sealing washers from outside, place over lever spindle and screw into position. Slide thrust washer and control lever together with torsion spring onto lever spindle. Rotate lever spindle with control lever in idling position so that the section of the cam adjusting lever riveted to the spindle points approximately 45° towards bottom rear. Tighten clamping screw of control lever.

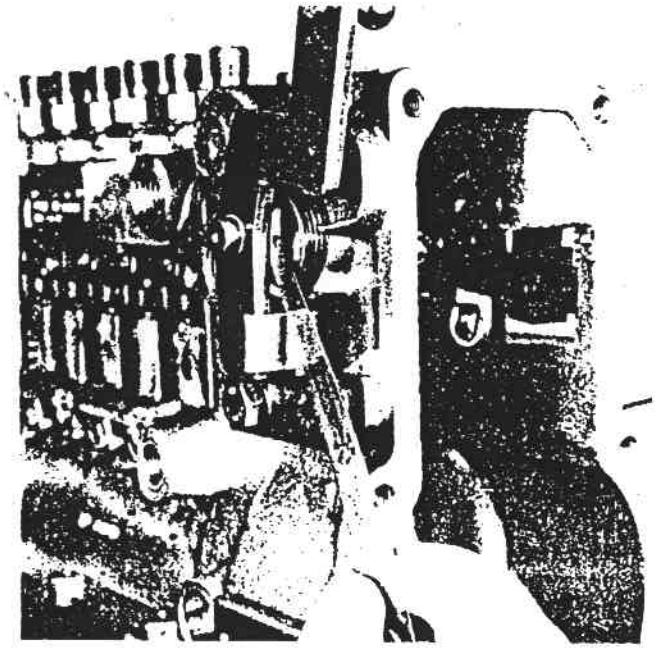


68

On governors of the more recent design, screw in hollow screw together with sealing washer.
Insert lever spindle with control lever and torsion spring.
Place cam adjusting lever onto lever spindle from inside.
Adjust clamping block of cam adjusting lever so that when the control lever is in its idling position the clamping block is approx. 45° towards bottom rear.
Tighten clamping screw.

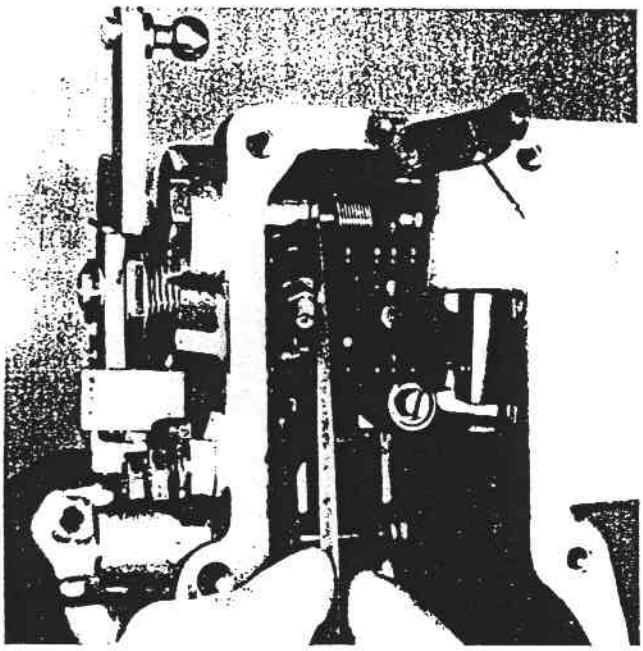


69



70

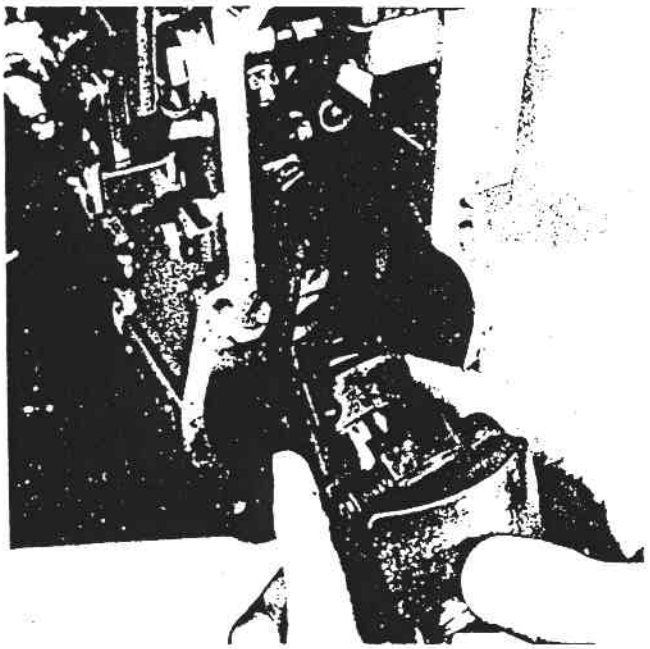
With feeler gauge check end play of lever spindle – max. 0.02 mm (0.00787 in).
Adjust by releasing the clamping screw and moving the control lever or cam adjusting lever along the lever spindle.



71

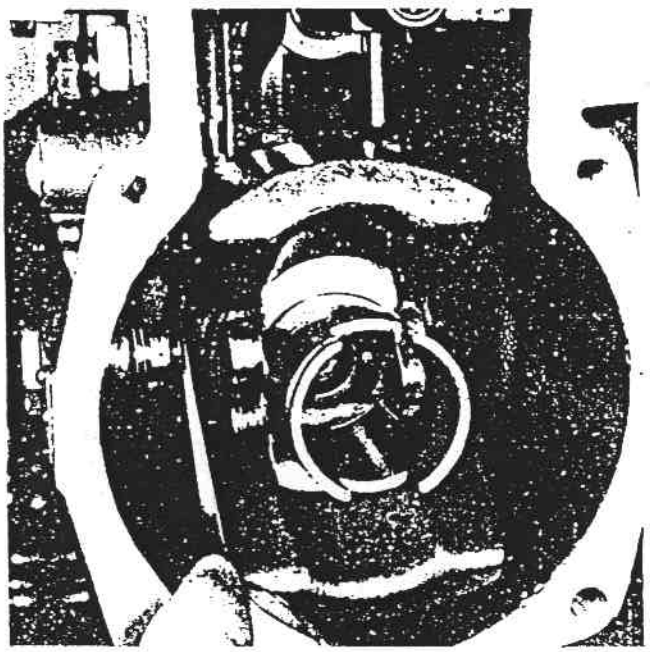
Screw in lever spindle of starting lever.
Simultaneously place starting lever together with torsion spring on lever spindle. Place retainer in position.
With feeler gauge check end play of starting lever – max. 0.1 mm (0.00394 in). Adjust by using spacing washers between retainer and starter lever. Connect tension spring between lever spindle and roller lever.

The following operations have to be carried out once again while adjusting the injection pump on the test bench (see Test Instructions VDT-WPP 711/1 B and ..1st supplement). They are not necessary in the case of repairs where subsequent setting and testing follow immediately.



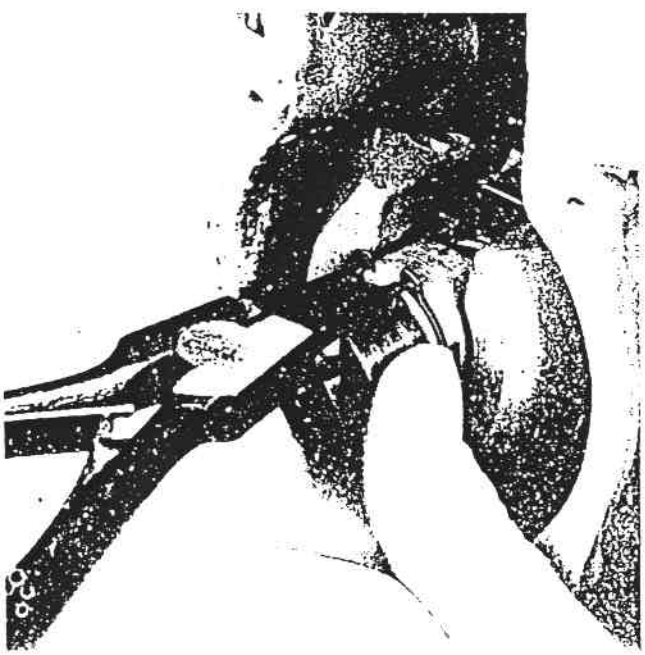
72

Insert spring-loaded buffer for cam adjusting lever.
Caution: Governors of the earlier design had a rigid mushroomshaped buffer. This buffer is no longer acceptable under any circumstances and it is absolutely essential that it be replaced by the spring-loaded version when making repairs.
From governor of type EP/RLA 1/9 R onward, the spring-loaded buffer inserted from the inside is replaced by a spring capsule screwed in from the outside.
Introduce ball head of cam adjusting lever into the bore of the cam. Place flyweight assembly complete with washers, cam and spring on camshaft taper. Screw ring nut together with spring washer onto camshaft thread and tighten with pronged wrench 1 687 950 012 - EFEP 187 A and torque wrench.



73

With feeler gauge check play between spring-loaded guide and cam adjusting lever – max. 0.1 mm (0.00394 in). Adjust by placing spacing washers under the spring-loaded guide.
While measuring, move control lever over its full range. The cam adjusting lever must not bind at any point nor must the spring be over-compressed.
Check: The control lever must automatically return from the full load position to the idling position.



74

Insert guide plate, spring seat, the three governor springs and the spring retainer, securing with retainer. Fit retainer in such a way that its noses are offset by approx. 90° in relation to the recesses in the spring retainer.

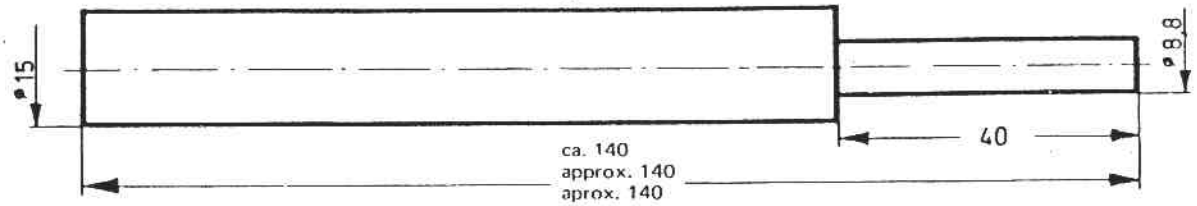
Screw into position during or after test: governor cover, start solenoid, stop solenoid, warm-up thermostat, cover for compensating unit, control valve housing with coolant thermostat, altitude compensator and spring compartment cover.
Test and adjust in accordance with Test Instructions VDT-WPP 711/1 B and ..1st supplement.
When fitting the air thermostat, note gasket, any intermediate plate, insulating plate and insulating washers under fastening screws.

5. Fixtures and tools

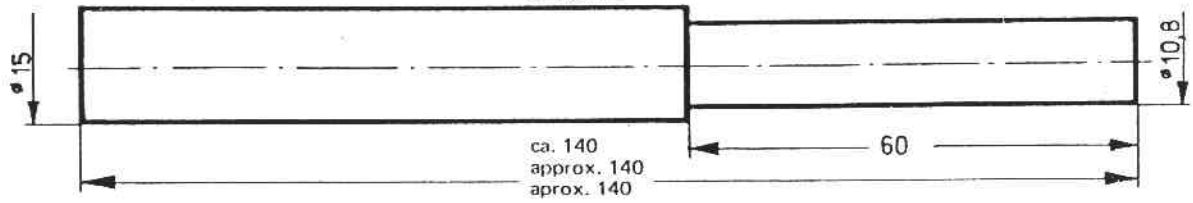
Clamping support for securing pump in conjunction with various other clamping fixtures	EF 8498	0 681 240 048
Universal clamping bracket for securing PES.. pumps in conjunction with suitable flange and clamping support 0 681 240 048	EFEP 157/20	1 688 040 009
Clamping flange, register diameter 68 mm (2 11/16 in), in conjunction with universal clamping bracket 1 688 040 009	EFEP 157/6	1 685 720 018
Clamping device for securing PED.. pump in conjunction with clamping support 0 681 240 048	KDEP 1006	–
Pronged wrench for releasing and tightening the ring nut on the governor flyweight assembly	EFEP 187 A	1 687 950 012
Intermediate adaptor with 1/2" internal square to suit 1 687 950 012 in conjunction with commercially available torque wrench	EFAW 131	1 680 390 002
Puller for drawing flyweight assembly from camshaft taper	EFEP 337	1 683 103 000
Assembly wrench for holding drive coupling to prevent rotation, with A/F 10 mm (5/8 in)	EFEP 119	1 683 080 000
Tappet holder for keeping roller tappets in "up" position on PES..KL../.. pump	EFEP 308 A	1 689 999 136
Tappet holder for pushing up roller tappets on PES..KL..A.. and PES..KL..B.. pumps	KDEP 1008	–
Tappet holder (eccentric pin) for pushing roller tappets up on PED..KL.. pumps	KDEP 1007	–
Tappet clamp for removing and fitting roller tappets	EF 8184 B	1 683 083 000
Valve lifter for removing delivery valves	EF 8117 A	0 681 340 009
Hand milling cutter for smoothing plunger and barrel seats in housing of PES..KL../.. pumps	EF 8488 B	1 687 910 003
Hand milling cutter for smoothing plunger and barrel seats in housing of PES..KL..A..-, PES..KL..B..- and PED..KL..-pumps	EF 8488 E	1 687 910 006
Hand milling cutter: The pilot spigot (12 mm / 15/32 in dia.) is required in conjunction with 1 687 910 006.	EF 8488 G	1 687 910 008
Measuring device for setting bearing assembly dimension "b"	EFEP 413	1 688 130 025
Dial indicator holder, in conjunction with auxiliary tool made on site to sketch 5, Page 30. For locating control rod in center position on PED..KL..-pumps.	EFEP 255	1 680 390 003
Plunger gripper for fitting pump plungers without plunger base spring and spring seat. (For checking free movement of plunger).	EFEP 76	0 681 340 002
Spring seat gripper for fitting pump plungers with plunger base spring and spring seat.	EFEP 457	1 688 110 030
Tappet clamp for preloading the plunger base spring	EFEP 458	1 687 953 011
Mounting sleeve for protecting shaft seal when fitting bearing end plate to drive end.	EFEP 294	1 680 390 004
End play measuring device for checking camshaft end play in conjunction with dial indicator 1 687 233 011 – EFAW 7.	EFEP 225	0 681 440 011
Dial indicator for checking camshaft end play and tappet backlash, in conjunction with suitable measuring devices.	EFAW 7	1 687 233 011
Measuring device for checking tappet backlash. (Possibly in conjunction with auxiliary tool made on site to sketch 6, Page 30).	EFEP 254	0 681 440 014

6. Auxiliary tools to be made on site
6. Outils auxiliaires à fabriquer soi-même
6. Herramientas auxiliares de propia confección

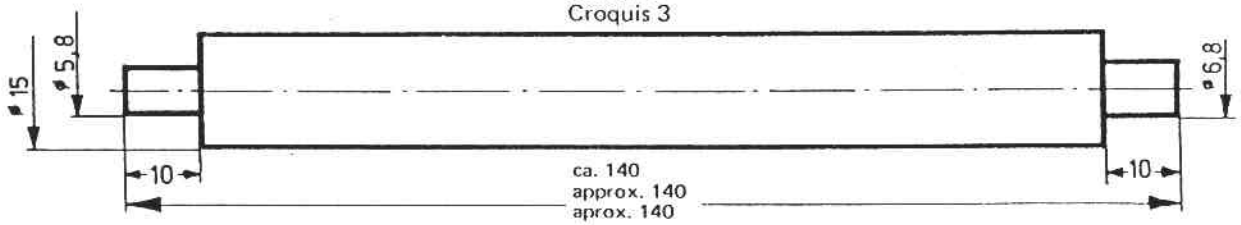
Sketch 1
Croquis 1



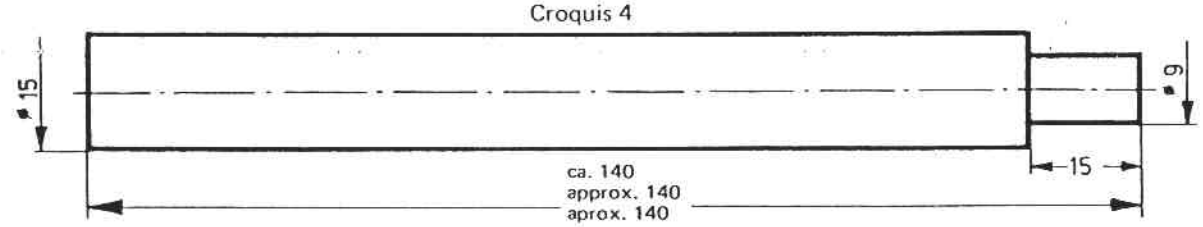
Sketch 2
Croquis 2

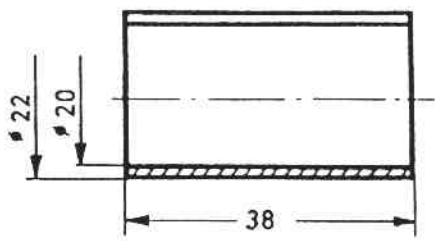


Sketch 3
Croquis 3

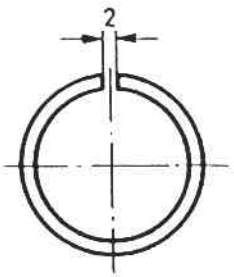


Sketch 4
Croquis 4

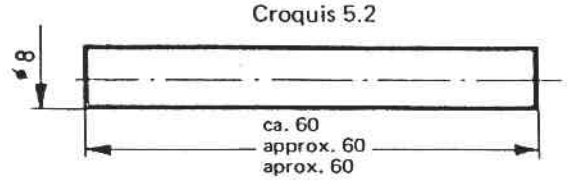




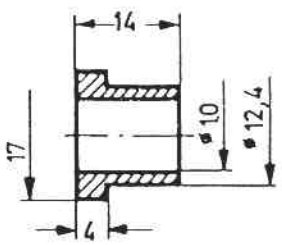
Sketch 5.1
Croquis 5.1



Sketch 5.2
Croquis 5.2



Sketch 6
Croquis 6



7. Tightening torques in kgf.m

Control rod guide bushings	1.5 – 2.0
Clamping screws for gear segments on tappet guides	0.15 – 0.25
Lock nut for start/stop solenoid	0.25 – 0.35
Fastening screws for governor housing	0.6
Spring-loaded mushroom-shaped guide piece in governor housing	3.0 – 3.5
Ring nut for flyweight assembly	4.0 – 4.5
Connection adaptor for oil inlet	2.0