

# CYLINDER HEAD AND VALVES

## Removing and Installing Rocker Arm Bracket 1600 Engine

Special Tools: VW 118 Torque Wrench 5 mkg (36 ft. lb.) capacity

19 EN

### Removal

1. Remove rocker box cover.
2. Remove spindle of long exhaust rocker by removing a lock ring.

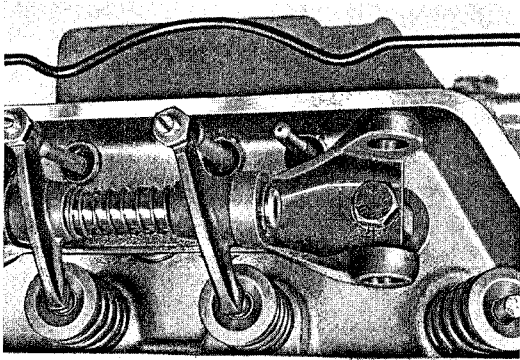


Fig. 125

3. Remove long exhaust rocker arm.
4. Remove rocker arm bracket screws.
5. Remove rocker arm bracket.

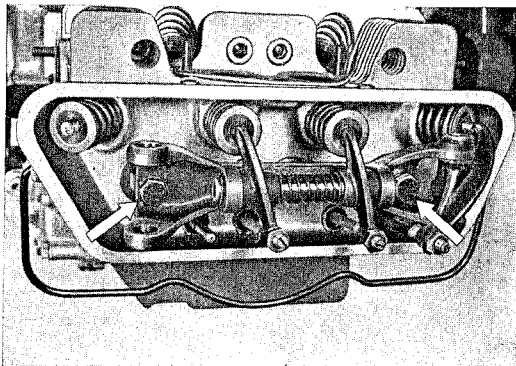


Fig. 126

### Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Clean oil passages in valve adjusting screws.
2. Adjusting screws must turn easily. Replace screws with worn or damaged threads.
3. Mounting screws for rocker arm brackets must be in good condition. Apply graphite grease to threads and underside of screw heads; insert new lock washers.
4. Tighten rocker arm bracket screws to 5 mkg (36 ft. lb.) torque.



Fig. 127

5. Install long rocker arm with 2 thrust washers.

6. Insert rocker spindle and secure with lock ring.
7. Adjust valves.
8. Oil spindle and push rods and install rocker box cover.

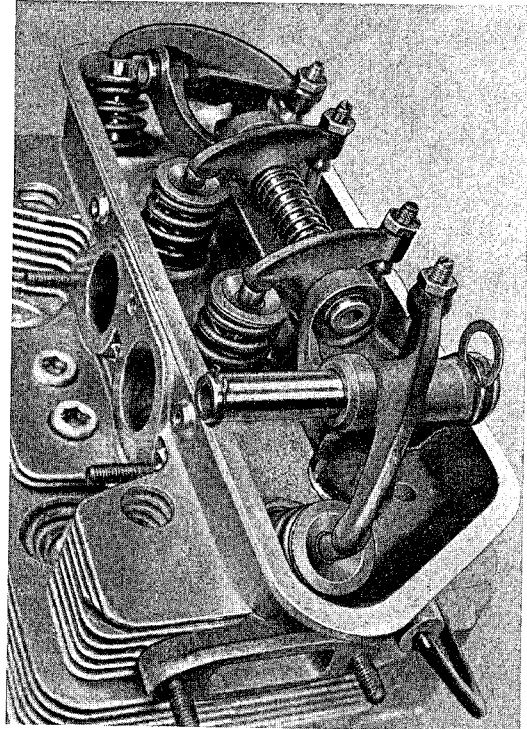


Fig. 128

## 20 EN

### Disassembling and Assembling Rocker Arm Bracket 1600 Engine

#### Disassembly

1. Remove rocker arm bracket (19 EN).
2. Remove circlips from spindles and push out spindles.
3. Remove adjusting screws.

#### Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

1. Inspect spindles and rocker arms for wear, replace if necessary.
2. Clean oil passages in adjusting screws and rocker arms.
3. Insert thrust washers in such a manner that rocker arms are centered over the valve stems. Also note that push rods do not touch the push rod tubes. Rocker arm lateral clearance must be 0.1 mm (.004 in.).
4. Insert spindles and secure with lock rings.
5. Install long rocker arm after installing rocker arm bracket.

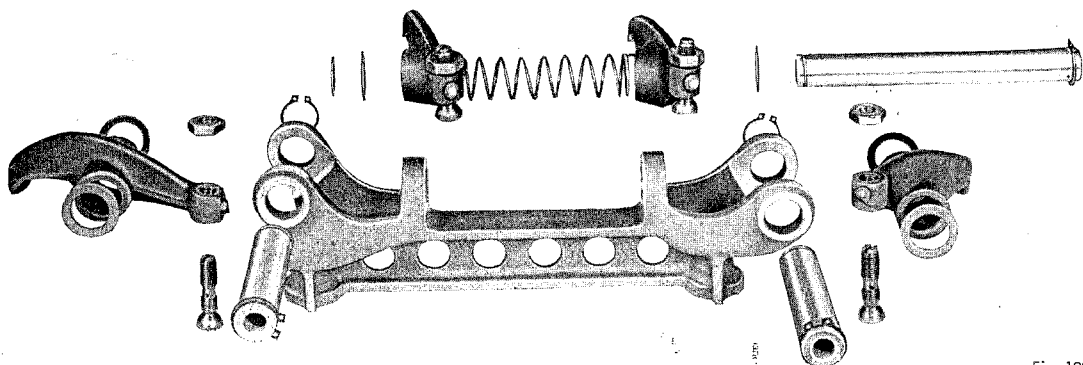


Fig. 129

## Removing and Installing Rocker Arm Bracket 1600 S Engine

21 EN

### Removal

1. Remove rocker box cover.
2. Remove 7 securing nuts (SW 13).

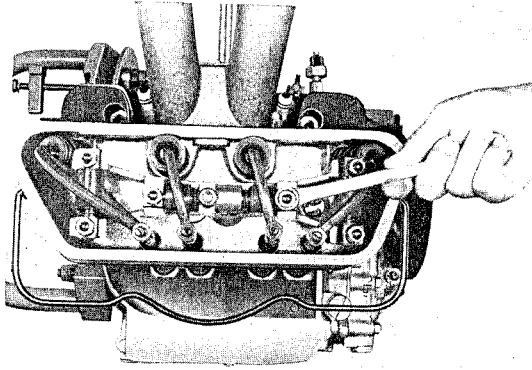


Fig. 130

2. Tighten screws to 5 mkg (36 ft. lb.) torque.

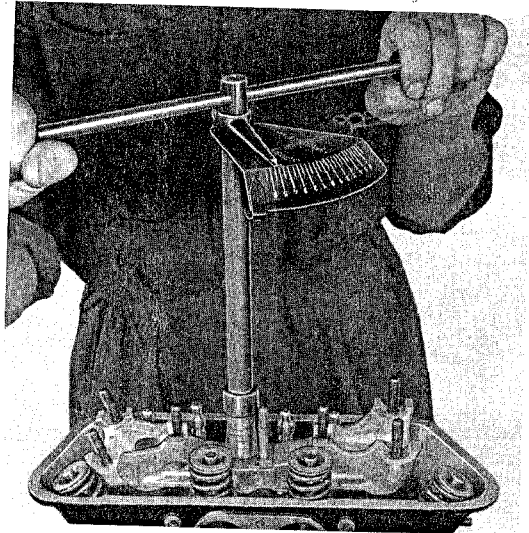


Fig. 132

3. Remove rocker arms with spindles, springs, washers, and clamps.
4. Remove 3 rocker arm bracket screws and remove bracket.

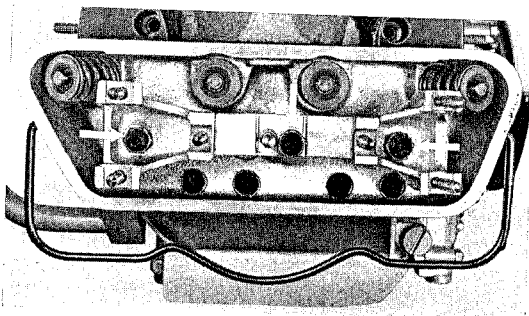


Fig. 131

3. Tighten securing nuts (SW 13) to 2.5 mkg (18 ft. lb.) torque.

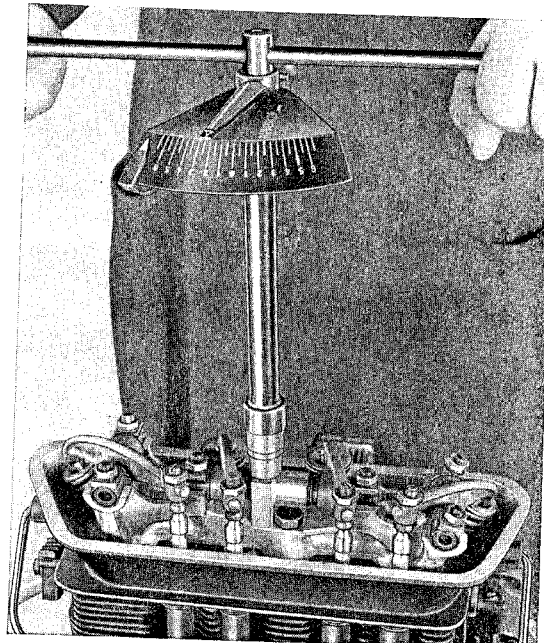


Fig. 133

### Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. Inspect rocker arm bracket screws for damage. Apply graphite grease to threads and pressure faces.

4. Adjust valve clearance.

5. Oil spindles and rocker arms and install rocker box covers.

## 22 EN

### Disassembling and Assembling Rocker Arm Bracket 1600 S Engine

#### Disassembly

1. Remove the 7 securing nuts.
2. Remove the rocker spindles, rocker arms, springs, washers, and clamps.
3. Remove adjusting screws.
2. Inspect adjusting screws and replace if threads bind or ball joint is damaged.
3. Clean oil passages in adjusting screws.

#### Assembly

The assembly is accomplished in the reverse order of disassembly observing the following points:

1. Inspect rocker arms and spindles replacing worn or damaged parts.
4. Insert thrust washers in such a manner that rocker arms are centered over the valve stems. Also note that push rods do not touch the push rod tubes.
5. It is important that washers, spacers, and clamps are properly arranged (Fig. 134).

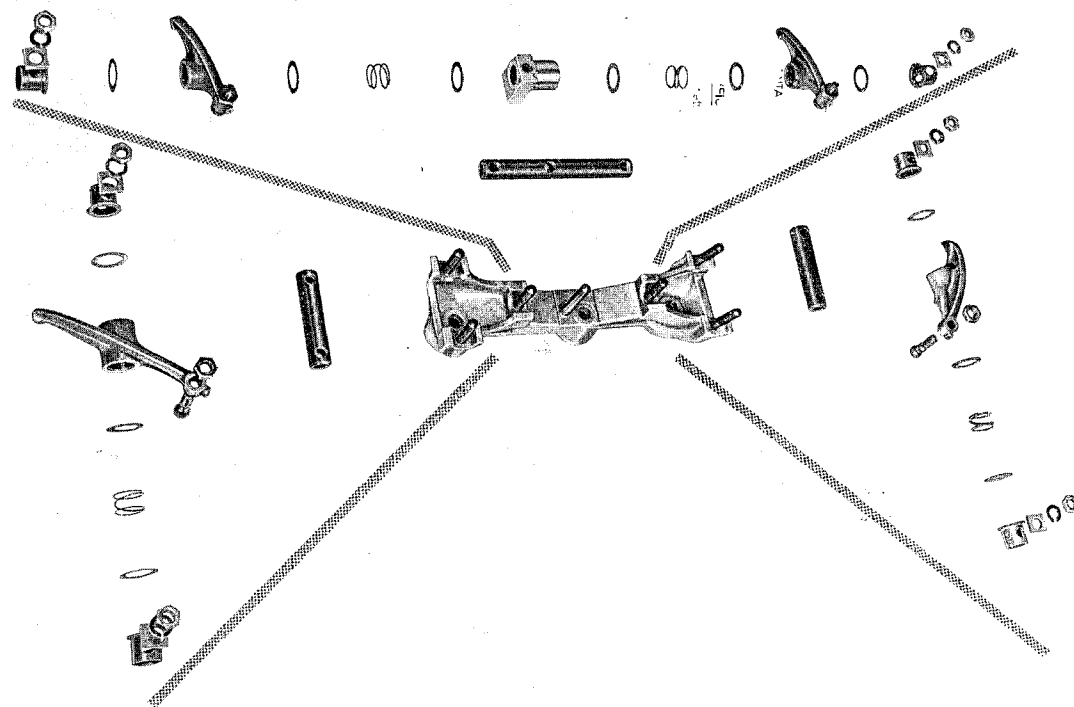


Fig. 134

## Removing and Installing Cylinder Heads

(Engine removed from car)

23 EN

Special Tools: P 23 Carburetor wrench 12 mm SW  
 P 3 Spark plug wrench  
 VW 157 Allen wrench socket used with VW 118 for cylinder head nuts  
 VW 118 Torque wrench used with VW 157 for cylinder head nuts

### Removal

1. Remove lower air guide, side duct plates, cylinder duct plates, carburetor, and intake manifolds.

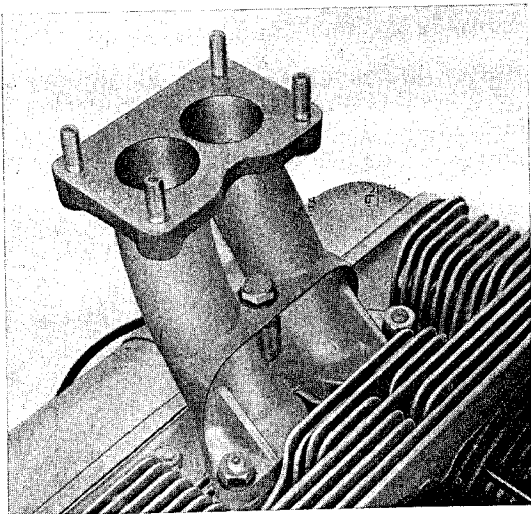


Fig. 135

2. Remove rocker box covers and rocker brackets (19 or 21 EN).
3. Remove cylinder head nuts with allen wrench and remove washers. See Fig. 136 for position of 8 nuts.

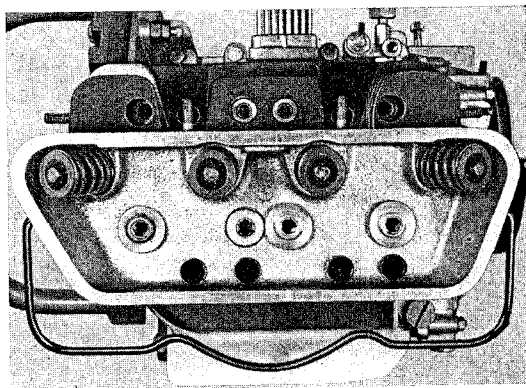


Fig. 136

4. Remove cylinder head.

### Installation

The installation is accomplished in the reverse order of removal observing the following points:

1. There are no cylinder head gaskets between the cylinders and heads.
2. Install push rod tubes. To insure a proper seal to the cylinder head and crankcase the bellows on the tubes must be expanded carefully avoiding ruptures.

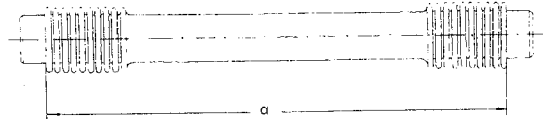


Fig. 137

Push rod tube "a" = 159 to 160 mm ( $6\frac{1}{4}$  to  $6\frac{11}{32}$  in.).

3. Install cylinder head insuring a good fit with the push rod tubes using new seals. Align tubes with seams up.

### Crankcase seal

### cylinder head seal

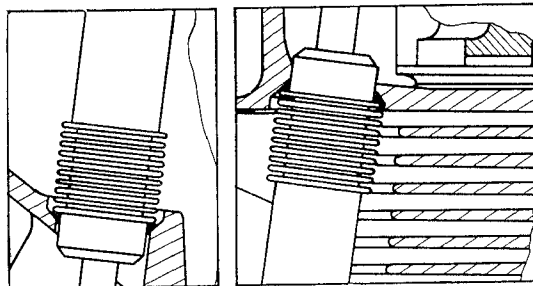


Fig. 138

4. The push rod tube seals are trapezoidal in cross-section.



Fig. 144

11. Oil push rods until oil runs out of bottoms and insert into push rod tubes. (1600 Engines steel push rods, 1600 S Engines light alloy push rods.)



Fig. 146

13. Install long rocker arm (1600 Engines).

14. Tighten clamp nuts (SW 13) to 2.5 mkg (18 ft. lb.) torque (1600 S Engines).

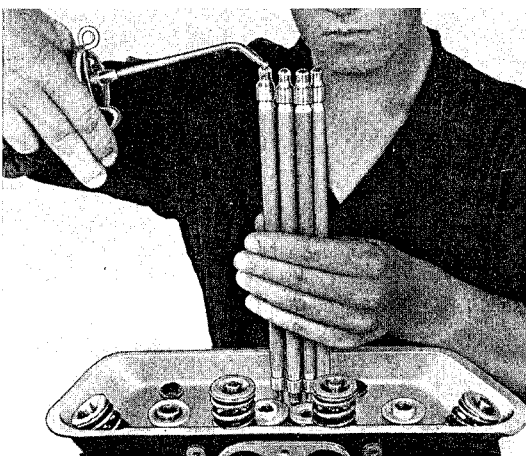


Fig. 145

12. Install rocker arm bracket and tighten to 5 mkg (36 ft. lb.) torque.

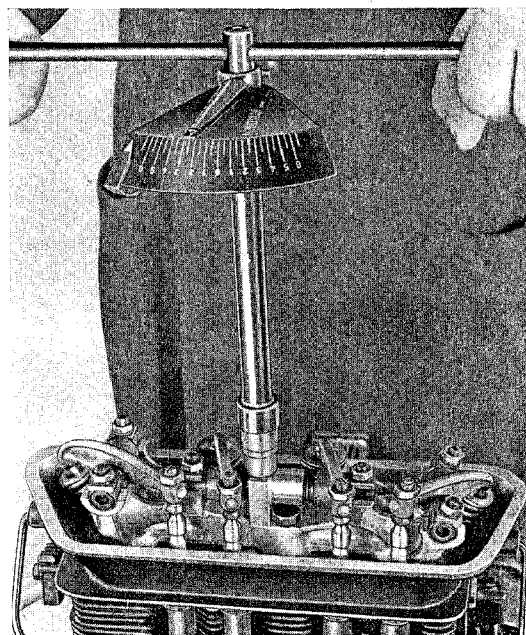


Fig. 147

15. Adjust valve clearance.

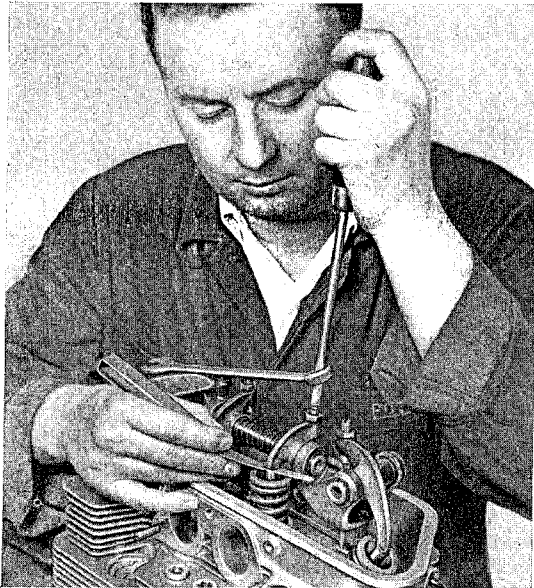


Fig. 148

16. Install rocker box covers.

**Note:**

When installing cylinder heads, care must be taken to insure that cylinders fit properly in the recesses of the cylinder heads. If cylinder heads are not squarely aligned when installing, cylinders may become distorted and damaged beyond repair.

**24 EN**

**Removing and Installing Valves**

**Special Tools:** P 7 Valve spring compressor assembly  
P 10a Gauge to measure length of installed valve springs

**Removal**

1. Remove cylinder head (23 EN).
2. Place cylinder head on spring compressor stand.

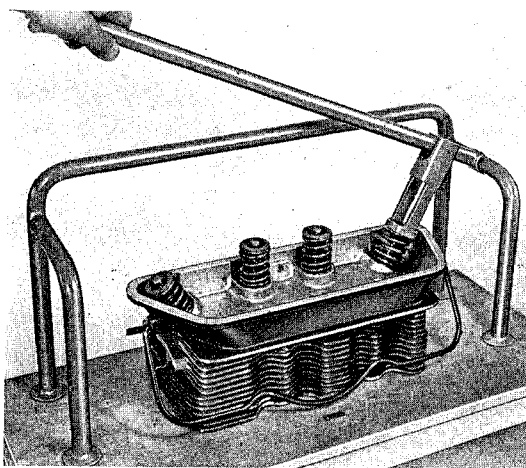


Fig. 149

3. Depress valve spring retainer and remove locks. Remove spring retainer.

4. Remove spring and spacer washers.

5. Remove burrs from valve stem ends to avoid gouging valve guides.

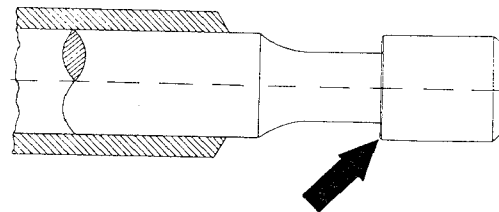


Fig. 150

6. Remove valves.

**Installation**

The installation is accomplished in the reverse order of removal observing the following points:



1. Check the valve springs in a standard valve spring tester.

LENGTH		PRESSURE
Free	47 mm	—
	1.850 in.	—
Compressed	41 mm	28 $\pm$ 1.4 kg
	1.615 in.	61.5 $\pm$ 3 lb.
	30.1 mm	92.5 $\pm$ 2.5 kg
Compressed		— 3.5 kg
	1.185 in.	204 $\pm$ 5.5 lb.
		— 7.7 lb.

A pressure variation of  $\pm 5\%$  is allowable for used springs.

2. Inspect springs before installing.
3. Check valve stems for alignment (0.01 mm, .004 in. max.).
4. Check valve guides for wear.
5. Check valves for wear and seating.
6. Remove any roughness from valve stems with fine emery cloth.

#### Checking Installed Valve Spring Length

Note:

The intake and exhaust valve springs are identical and are brought to the proper installed length by inserting or removing washers.

1. Install special tool P 10a with spring retainer and locks on the corresponding valve.
2. Read measured length and adjust with spacer washers until the required length is obtained.

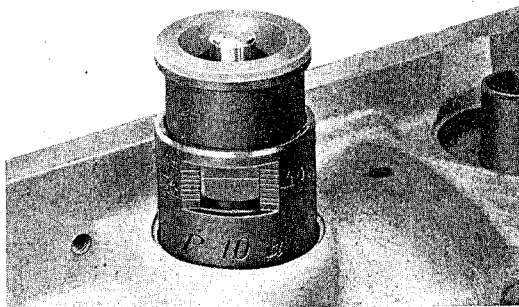


Fig. 151

3. Install valve spring with closely wound coils toward the cylinder head.

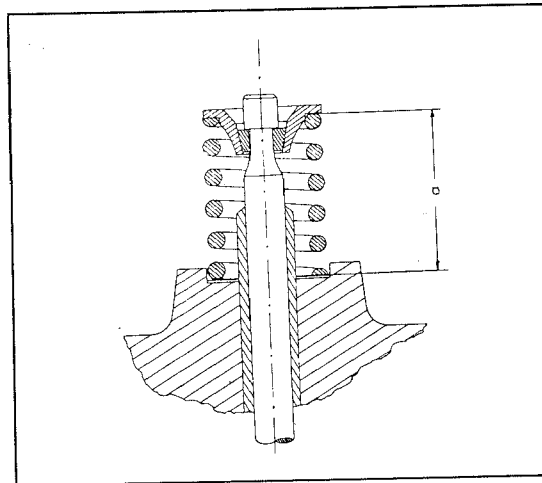


Fig. 152

Installed length of intake valve springs  
42.5 mm, 1.675 in.  
Installed length of exhaust valve springs  
41.5 mm, 1.635 in.

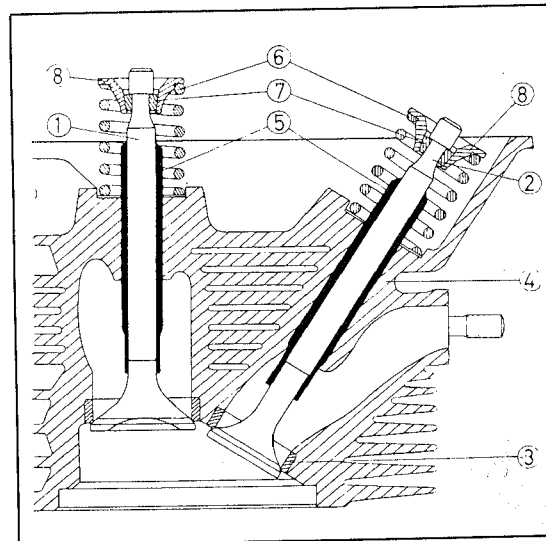


Fig. 153

- |                 |                         |
|-----------------|-------------------------|
| ① Intake valve  | ⑤ Valve guides          |
| ② Exhaust valve | ⑥ Valve springs         |
| ③ Valve seat    | ⑦ Spring retainer locks |
| ④ Cylinder head | ⑧ Valve spring retainer |



**25 EN**

### Checking Valve Guides

Special Tools: P 21b Limit gauge for valve guides

Valve guides may not be replaced with equipment normally available in workshops, since they are cooled to a very low temperature before installing to insure a tight interference fit. Forcing out guides can cause damage to the cylinder head.

Cylinder heads should be returned to the factory for replacement of valve guides.

Valve stem clearance in the guides is:

Intake: 0.035 to 0.060 mm (.0014 to .0024 in.)

Exhaust: 0.055 to 0.080 mm (.0022 to .0032 in.)

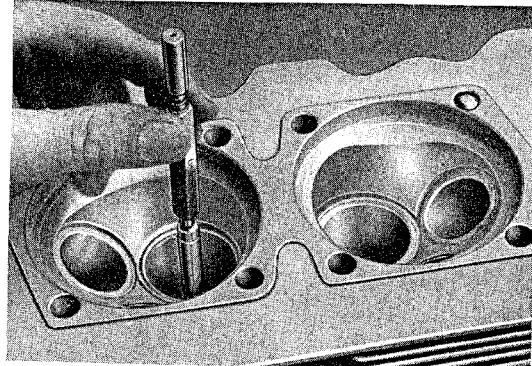


Fig. 154

**26 EN**

### Checking and Facing Valve Seats

Special Tools: P 11 Valve seat cutter consisting of a holder and 10 mm dia. guide pin

P 12 Cutter set consisting of 8 cutters

#### Checking

1. Check whether valve guides are secure in cylinder head.
2. Check valve seating using engineer's blue on the valve face.
3. Check contact of valve. If valve does not contact the entire seat face, reface with cutter.
4. To check whether valves leak, fill port with fuel.

#### Valve Cutting:

Valve seats which are worn or burned can be recut as long as the maximum 45° seat width is not exceeded and the 15° bevel does not go beyond the seat insert.

If this is not the case the cylinder head must be exchanged. It is not possible to replace the valve seats with the equipment normally available in a workshop.

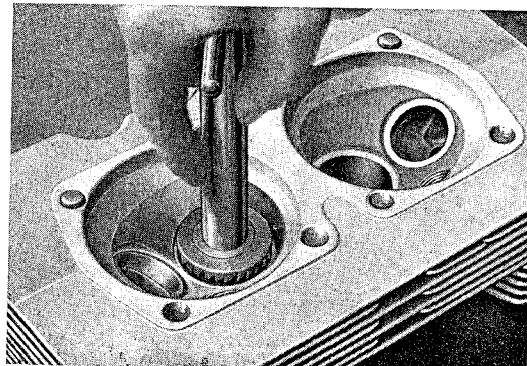


Fig. 155

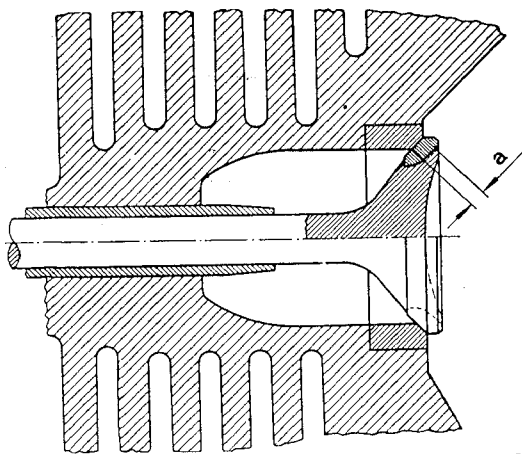


Fig. 156

#### Valve seat width "a"

Intake: 1.1 to 1.4 mm (.043 to .055 in.)

Exhaust: 1.4 to 1.7 mm (.055 to .067 in.)

#### Cutting sequence

##### 1. Cut 45° surfaces.

When cutting this surface it is important that the cutter is centered and does not chatter so that a smooth finish is obtained. Pressure must be applied vertically to prevent wobble. Remove as little material as possible to avoid replacing seats. When the cutter has cleaned the entire seat face remove the cutter.

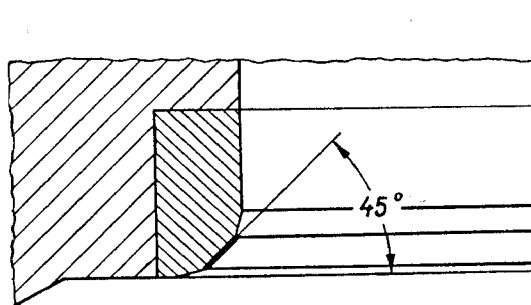


Fig. 157

##### 2. Cut 75° surfaces.

Bevel the inner edge of the seat lightly with the 75° cutter.

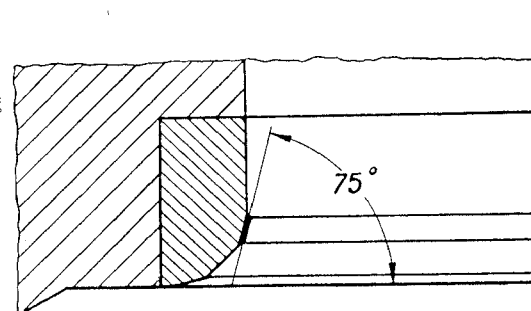


Fig. 158

##### 3. Cut 15° surfaces.

Bevel the upper edge of the seat with the 15° cutter until the required seat width is obtained.

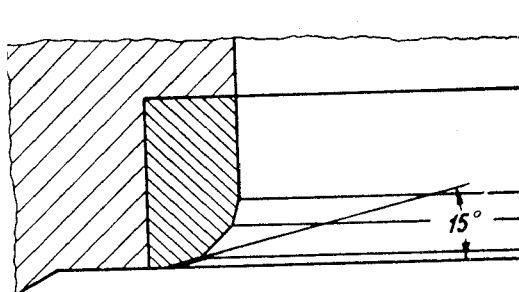


Fig. 159

## Grinding Valves

27 EN

Valves with pitted or worn faces should be refaced on a valve grinding machine.

When refacing valves, remove only enough material

to clean the face. Care must be taken that the stone does not contact the valve stem since valves with rough or gouged stems must be replaced.

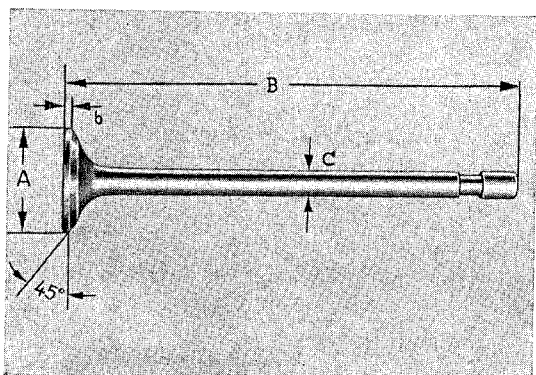


Fig. 160

Valve Dimensions					
10 mm (.394 in.) dia. Stem					
Exhaust			Intake		
A	37.9 to 38.1 mm 1.492 to 1.500 in.		30.9 to 31.1 mm 1.217 to 1.224 in.		
B	119.4 to 119.6 mm 4.70 to 4.71 in.		130.5 to 130.7 mm 5.13 to 5.14 in.		
C	9.98 to 9.99 mm .3929 to .3933 in.		9.96 to 9.97 mm .3921 to .3925 in.		
b	1.7 to 2.3 mm .067 to .091 in.		2.0 to 2.3 mm .079 to .091 in.		

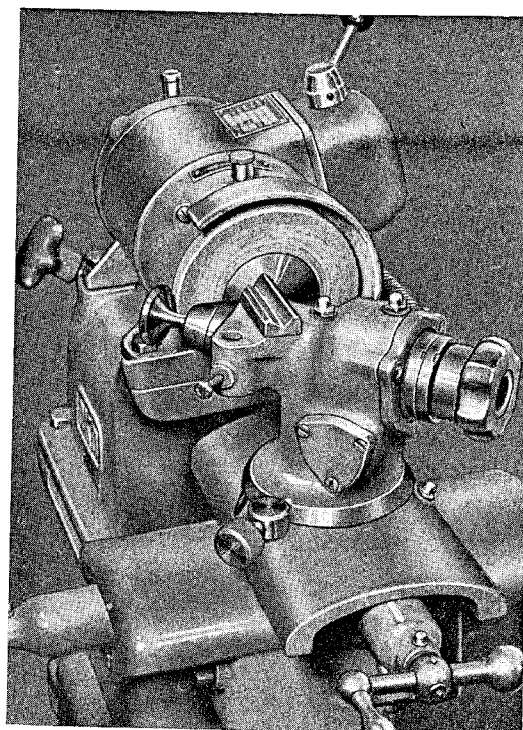


Fig. 161

28 EN

### Seating Valves

Special Tools: P 9 Suction cup valve grinder

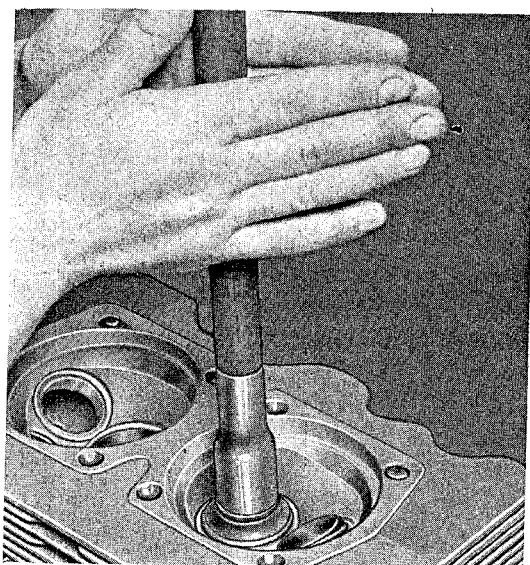


Fig. 162

Observe the following points when seating valves:

1. Use a fine grained grinding paste to avoid seat roughness.
2. Seat valves using suction cup P 9.
3. Thoroughly clean grinding paste from cylinder head.

#### Note

Grinding paste is water soluble and should not be mixed with oil. Wash cylinder head and valves with water after seating; dry and oil parts before installing.

## Inspecting Valves

29 EN

1. Clean carbon deposits from valves.
2. Check valve seats and grind if necessary.  
When grinding the valves dimension "b", (Fig. 160) especially on exhaust valves, may not be exceeded.
3. Valves with mushroomed or dented stems must be replaced.
4. Valves with bent stems, burnt or dented seats, or worn stems must be replaced. Straightening and grinding will not suffice.

## Testing Valves for Seating

30 EN

Valve seating can be checked on an assembled cylinder head by filling gasoline into the respective ports. No gasoline will leak through a properly seated valve.

## Adjusting Valve Clearance

31 EN

Valve adjustment is carried out in sequence on cylinders I through IV. The piston of the valves being adjusted must be at TDC to insure that the valves are fully closed.

When starting with cylinder I, rotate the crankshaft by turning the V-belt pulley until both valves are closed and the timing mark on the pulley is aligned with the timing mark on the timing case cover.

### Adjustment

1. Remove rocker box cover.
2. Set cylinder to be adjusted to TDC.
3. Check clearance with a feeler gauge.
4. Loosen lock nut.
5. Adjust clearance using a screwdriver and feeler gauge (Fig. 163).



Fig. 163

6. Hold adjusting screw while tightening lock nut.
7. Recheck adjustment with feeler gauge.
8. Repeat operation on remaining valves.
9. Install rocker box covers.

## Valve Clearance and Timing

Valve clearance are given for "cold" (room temp.) engines as follows:

### Timing

1600	1600 S	Engine Type	1600	1600 S
<b>Intake:</b> 0.10 mm .004 in.	<b>Intake:</b> 0.15 mm .006 in.	Intake opens before TDC	7°	17°
<b>Exhaust:</b> 0.15 mm .006 in.	<b>Exhaust:</b> 0.10 mm .004 in.	Intake closes after BDC	45°	53°
		Exhaust opens before BDC	44°	50°
		Exhaust closes after TDC	6°	14°

Valves should be adjusted according to the listed clearances. Incorrect valve settings will cause damage in the following ways:

#### Insufficient clearance:

- Burned valves and seats
- Distorted valves
- Altered valve timing
- Irregular running

#### Excessive clearance:

- Loud valve gear
- Increased wear
- Altered valve timing
- Irregular running

Correct valve adjustment is not effective unless the valves are in good condition and seat properly.

### Note

These values are valid for a valve clearance of **1.00 mm (.039 in.)** with a cold engine. Readjust the valve clearance to operating values after checking timing.

After grinding valves and seats adjust clearances 0.15 mm (.006 in.) greater than normal to allow for setting of valves during a test run of at least one half hour.

Adjust valves to correct clearance after test run.

## Exchanging and Reconditioning Cylinder Heads

Cylinder heads with valve guides or seats which cannot be locally repaired should be sent to the factory.

New cylinder heads are individually measured and marked with the volume of the combustion chambers. It is important to install only cylinder heads of matched volumes  $\pm 1$  cc.

Reconditioned cylinder heads are recalibrated and stamped with the new volume.

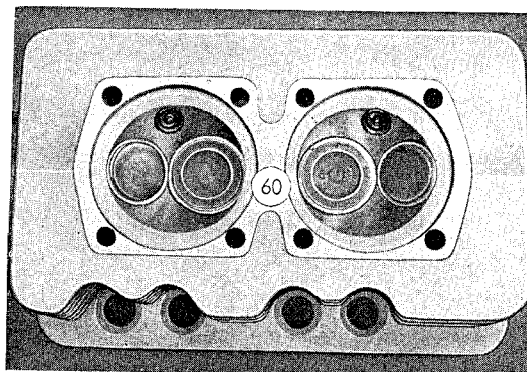


Fig. 164