Rear Axle and Transmission

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Contents:

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Description of Rear Axle

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General Description

Transmission, rear axle, and engine are combined in the rear of the car. The rear axle is of the swing half axle type. The rubber-cushioned transmission case is secured to the frame at three points. It incorporates the transmission and the differential.

Transmission Case

The bipartite transmission case is cast of light alloy. It must be clearly understood that when replacements are necessary it is not permissible to replace a single half of the transmission case. They are machined in pairs to very close limits and in consequence replacements must be made in pairs.

Transmission

The transmission has four speeds forward and one reverse, which is provided with a stop. Synchromesh is obtained with the helical 2nd, 3rd, and 4th gears are which are in constant mesh to insure quiet operation.

Gear ratios:

1st	3.60 : 1
2nd	1.88 : 1
3rd	1.22 : 1
top	0.79 : 1
reverse	4.63 : 1

Gear Control

The shifting rod in the frame tunnel links the transmission to the gearshift lever, which is located on the tunnel beside the driver's seat. Shifting of first and reverse is effected by sliding gears. Synchronizing devices are used in shifting to 2nd, 3rd, and 4th. The synchro-system consists of clutch gear, synchronizer shifting plates, synchronizer stop ring, and operating sleeve.

The operating sleeve is splined to the clutch gear, which in turn is splined to the drive pinion shaft. The synchronizer stop ring is held in position by the three shifting plates which are in slots let into the outer diameter of the clutch gear radially, 120° apart. The first and reverse gear also performs the function of an operating sleeve when shifting to second.

An interlock mechanism is provided to assure positive gear engagement and prevent the selection of more than one pair of gears at a time.

The synchronizer stop rings are provided with internally female coned surfaces which are designed to engage with similary shaped male coned surfaces on the gears. When the operating sleeve is moved towards the gear which is to be engaged, the three shifting plates bring the coned surface of the synchronizer stop ring into contact with the coned face of the gear. The faster moving gear carries the synchronizer stop ring round until the ring is stopped by the shifting plates. This is only a small arcuate movement, bringing the stop ring teeth out of line with the internally cut splines in the operating sleeve. The braking effect, which produces synchronization, takes now place between the two cone surfaces. When exact synchronization of speed is reached, the splines of the operating sleeve engage with the teeth of the synchronizer stop ring and then with the clutch teeth of the gear. This engagement is facilitated by the teeth being chamfered.

To insure a correct operation of the synchro-system, it is of utmost importance to release the clutch completely. The clutch pedal free play should be, therefore, periodically checked. Insufficient declutching or a dragging clutch plate (e. g., by damaged clutch plate lining or distorted clutch plate) lead to rapid wear of the synchronizer stop rings. With the clutch plate completely locked, which may be caused by a broken plate lining, it is not possible to shift gears, as synchronism cannot be reached. Only accredited clutch linings should be used.

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Each time an engine has been re-installed in the car, it should be made sure that the clutch fully releases by declutching and shifting into first with the engine running.

More detailed information is given in the section "Clutch".

Final Drive

Power is transmitted through a helically-cut drive pinion and ring gear (crown wheel), provided with differential bevel gears, via two swinging axles to the rear wheels. Silent operation and a long service life of the final drive mechanism are only insured by carefully adjusting drive pinion and ring gear.

Gear ratios:

Klingelnberg toothing	4.43 : 1
Gleason toothing	4.37 : 1

The differential is to compensate the difference of wheel travel as the car makes a turn, thus maintaining an equal drive of the wheels.

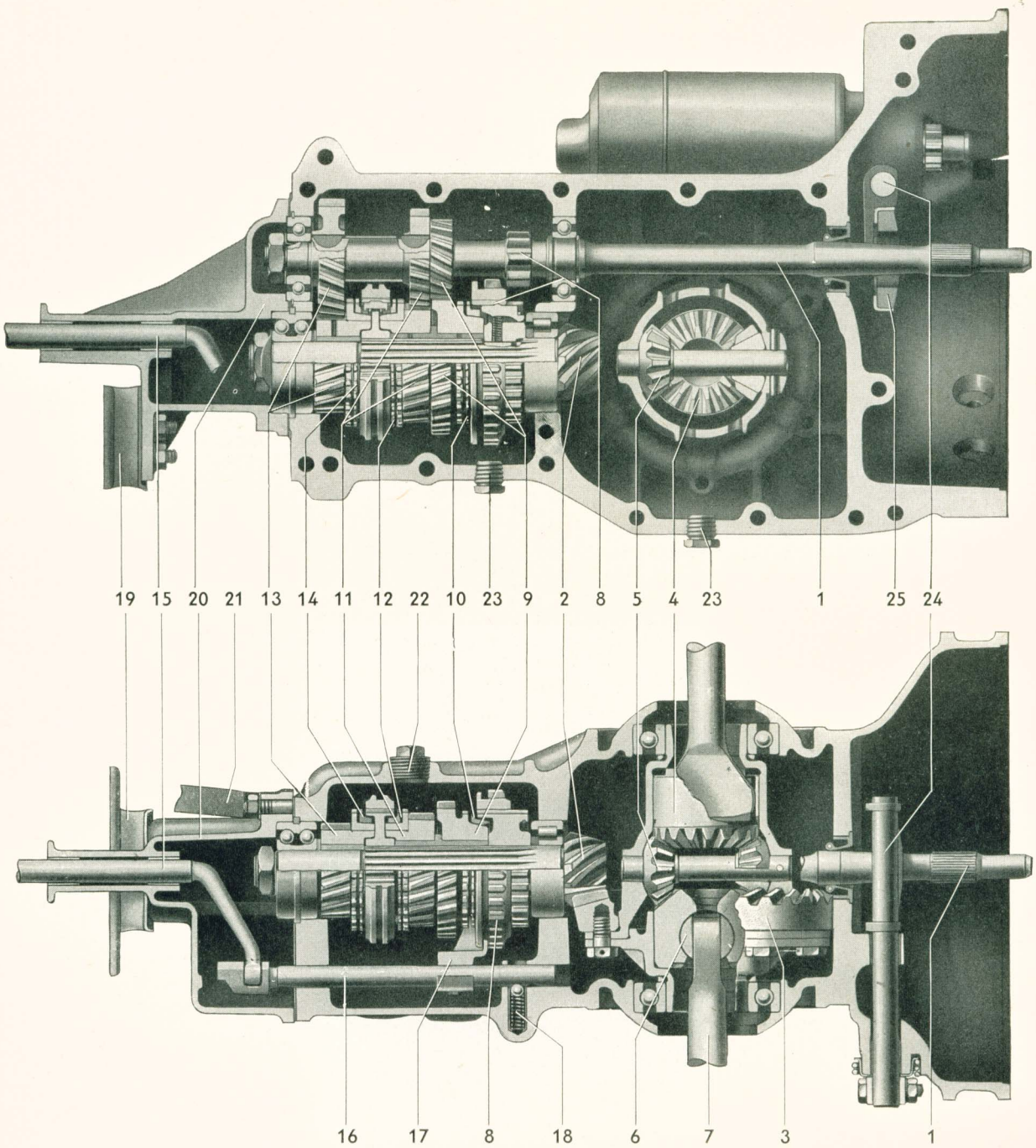
Rear Suspension

The rear wheels are sprung independently. Road shocks are transmitted to the left or right torsion bar by a spring plate on either side of the rear axle. The torsion bars are anchored in the center of the cross tube and secured against twisting by a spline engagement.

An accurate adjustment of the rear wheel suspension is effected by means of the splines cut in both ends of each torsion bar in different numbers. Hydraulic double-acting shock absorbers of the telescopic design dampen road shocks and prevent excessive rebound.

Oil Capacity

The oil capacity of the transmission case is 2.3 liters (4.8 U. S. pints; 4 Imp. pints). The oil should be changed at intervals indicated in the Lubrication Chart, using oil of the proper specification. When changing oil, the transmission case should be refilled with 2.0 liters (4.2 U. S. pints; 3.5 Imp. pints).



Volkswagen — Rear Axle and Transmission

(Sectional View)

1 - Main Drive Shaft
2 - Drive Pinion
3 - Ring Gear (Crown Wheel)
4 - Differential Side Gear
5 - Differential Pinion
6 - Fulcrum Plate
7 - Rear Axle Shaft
8 - 1st Gear Train
9 - 2nd Gear Train
10 - Synchronizer Stop Ring (2nd Gear)
11 - 3rd Gear Train
12 - Synchronizer Stop Ring (3rd Gear)
13 - 4th Gear Train
14 - Synchronizer Stop Ring (4th Gear)
15 - Transmission Shift Rod
16 - Selector Shaft
17 - Selector Fork
18 - Detent Spring and Ball
19 - Front Rubber Cushion
20 - Garshift Housing
21 - Ground Strap
22 - Oil Filler Plug
23 - Oil Drain Plug
24 - Clutch Operating Shaft
25 - Clutch Release Bearing

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Removing and Installing Rear Axle

Removal

If it is intended to disassemble the rear axle upon its removal from the vehicle, loosen the axle shaft nuts and the wheel bolts before lifting the vehicle.

1 - Disconnect battery ground (earth) cable.

2 - Lift car, support it on trestles and remove engine.

3 - Remove rear wheels.

4 - If the rear axle is to be disassembled afterwards:

Remove axle shaft nuts with Special Wrench VW 112 or with Torque Wrench VW 118/30 in conjunction with Socket VW 163a and withdraw brake drum and oil deflector.

5 - Disconnect brake line at rear. Remove brake shoe return springs, brake shoes, brake levers, and brake cable brackets. Withdraw brake cables from back plates.

Note. — When exchanging rear axle, the brake cables and brake drums remain on the axle. Unhook brake cables from brake push bar at frame head and withdraw them from the conduit tubes toward the rear. The brake lines between the back plates and the clamps on the rear axle tube should be removed.

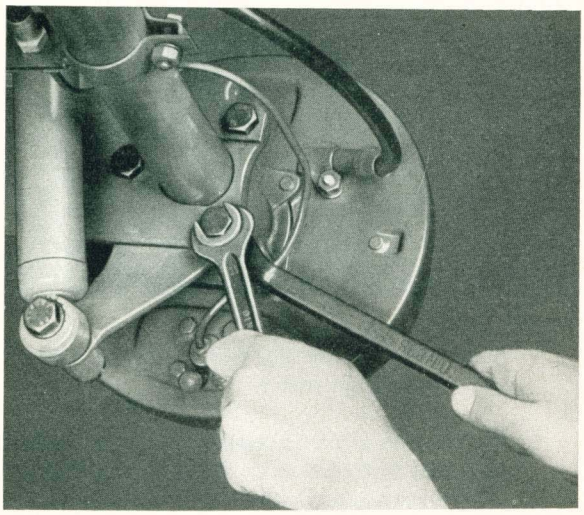
6 - Remove bolts at rear axle shaft bearing housing.

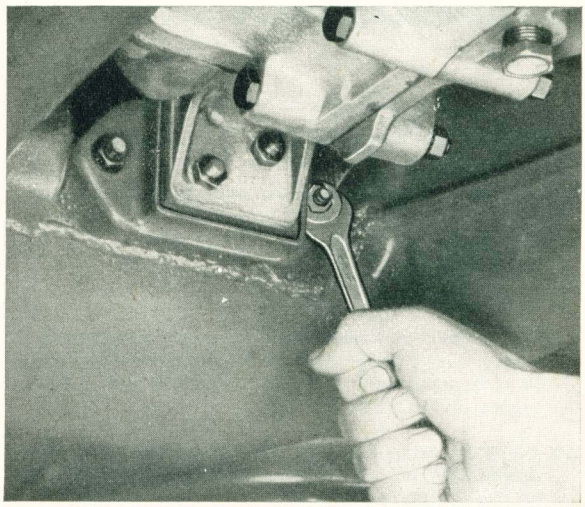
7 - Disconnect clutch cable from clutch operating shaft lever and withdraw it from guide plate.

8 - Disconnect cables from terminals 30 and 50 at starter motor.

9 - Remove frame end cover plate under rear seat. Remove the rear screw of the shifting rod coupling, using T-Wrench VW 114, and move the gearshift lever to withdraw the coupling from the transmission shift rod.

10 - Remove nuts at transmission front rubber cushion.





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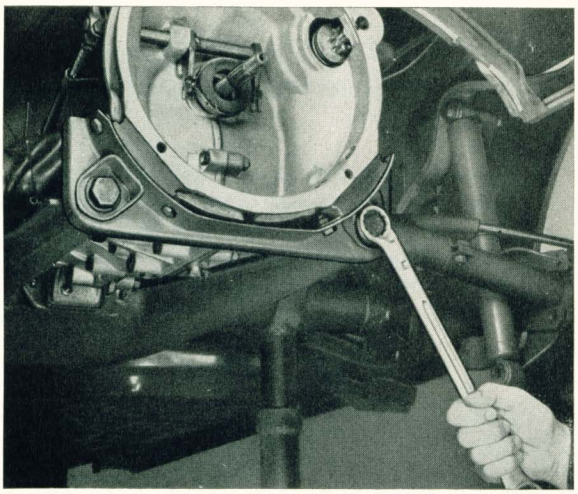
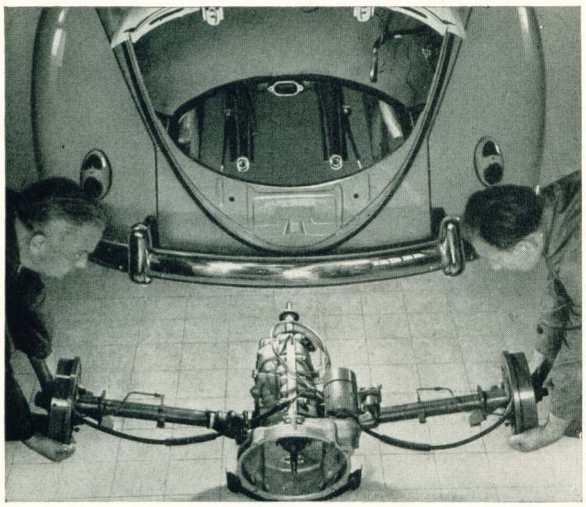
11 - Remove the two bolts at transmission carrier, using wrench VW 110.



12 - Withdraw the axle assembly from the rear of the vehicle.

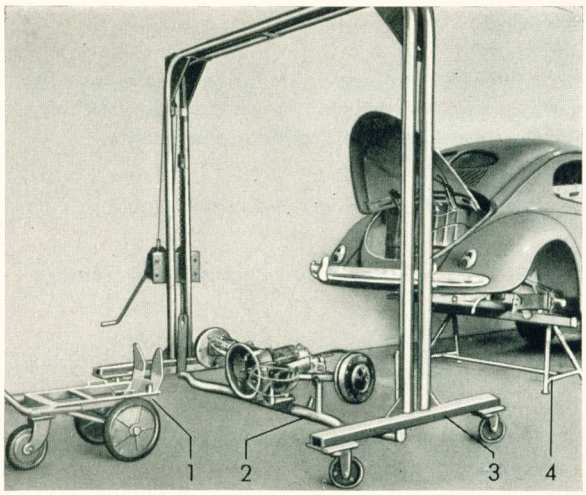


Attention! Take care no to damage the dust sleeves.

Note

a) The removal and installation of the rear axle is facilitated by using the gantry VW 301 (local manufacture) in conjunction with the cross tube. The car is supported on the trestle VW 372a.

b) When lowering the rear axle, take care the main drive shaft does not strike the floor. Rear axles should be stored on wooden supports to avoid damage.



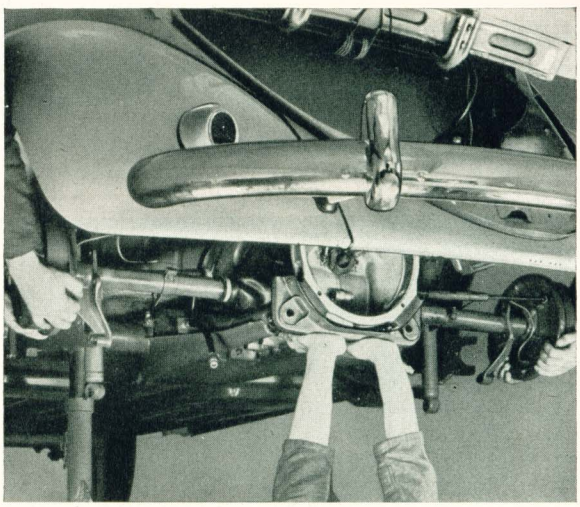
1 - Transport cart
2 - Gantry cross tube
3 - Gantry
4 - Trestle

Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

1 - Replacing the rear axle between the fork at the frame end can best be carried out by three mechanics.

Attention! Take care not to damage the dust sleeves.

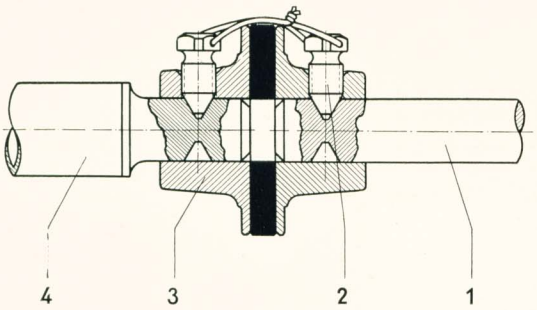


2 - Sufficiently grease the two mounting bolts at the transmission carrier.

3 - Tighten nuts at transmission front rubber cushion and then tighten nuts of the screws that attach the transmission carrier to the rubber cushions.

This order to tightening the nuts should be strictly followed to avoid distortion and premature wear of the rubber cushions.

4 - Make sure that the points of the coupling screws are correctly bedding in their recesses. Secure screws with a piece of wire.



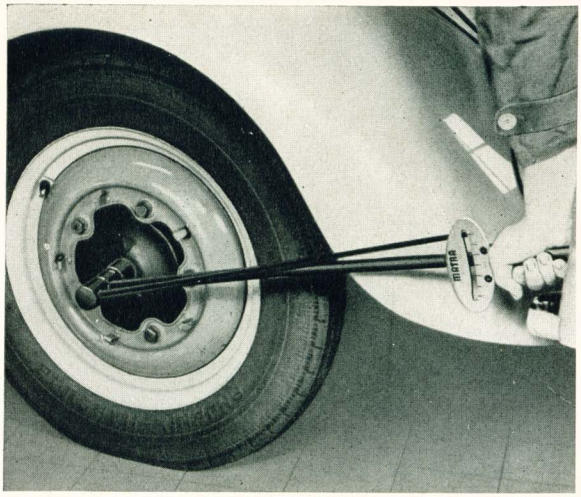
1 - Shifting rod
2 - Coupling
3 - Screw
4 - Transmission shift rod

5 - When the engine has been replaced, adjust clutch pedal free-play to 10—20 mm (0.4″—0.8″).

6 - Securely tighten shock absorber nuts.

7 - Check splines in hub of brake drum. Renew brake drum if splines are worn or damaged.

8 - Tighten rear axle shaft nuts by means of torque wrench VW 118/30 (30 mkg/217 ft. lbs.) and secure them with new cotter pins. The nuts should be tightened after the car has been lowered to the floor.



9 - Bleed and adjust brake system.

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Disassembly and Assembly of Rear Axle

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It is recommended to adopt the following sequence of operations for the disassembly and assembly of the rear axle:

Disassembly

1 - Attach rear axle (left transmission case half) to fixture VW 307 on stand VW 308.

2 - Remove both drain plugs.

3 - Remove starter motor.

4 - Remove transmission carrier.

5 - Remove clutch release bearing.

6 - Remove axle shaft nuts and withdraw brake drums.

7 - Remove brake back plates.

8 - Remove rear axle tubes.

9 - Remove gearshift housing.

10 - Disassemble transmission case.

11 - Take off main drive shaft.

12 - Take off drive pinion.

13 - Remove differential housing and axle shafts.

14 - Remove selector shafts, selector forks, and detent balls and springs.

15 - Take off reverse sliding gear shaft.

Assembly

Assembling the rear axle is a reversal of the above operations. Reference should be made, however, to the following pages containing detailed information and special hints as to the correct removal and installation of the individual parts.

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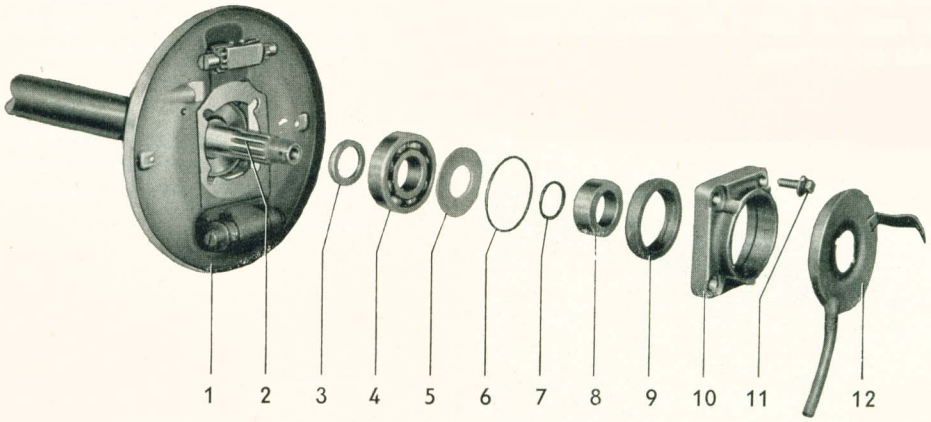
Renewing Oil Seal or Rear Wheel Bearing



1 - Brake back plate
2 - Axle shaft
3 - Inner spacer
4 - Ball bearing
5 - Washer
6 - Gasket
7 - Gasket
8 - Outer spacer
9 - Oil seal
10 - Cover
11 - Cover retaining screw
12 - Oil deflector

Removal

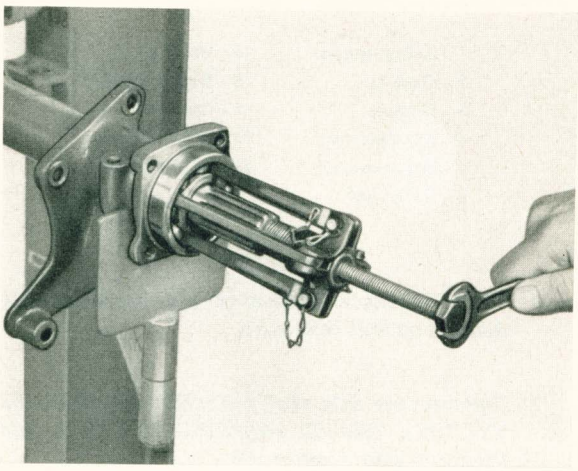
1 - Remove brake drum and oil deflector.

2 - Remove cover retaining screws and take off cover and oil seal.

3 - Remove brake back plate.

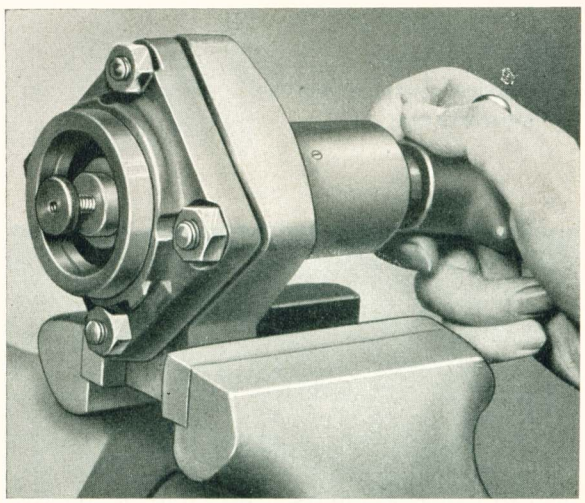
4 - Take off outer spacer, gasket between spacer and ball bearing, washer, and cover gasket.

5 - Remove rear wheel bearing, using extractor VW 241 T and take off inner spacer.



Removing and Installing Oil Seal

1 - If the oil seal lip is uneven or damaged, the oil seal should be removed from the cover by means of the tool VW 230.



2 - Lightly coat new oil seal with oil and press it in position, using tool VW 230 or Repair Press VW 400 in conjunction with VW 401, 408, 441, 442, and 443 or 444.

The seating depth is between 4.7 and 5.0 mm (0.185'' and 0.197'').

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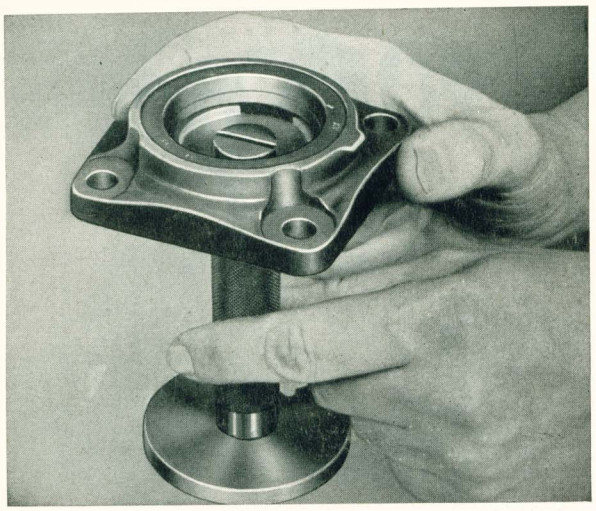
3 - Ckeck if oil seal beds squarely in the cover by using the gauge VW 230a/3. The depth is measured from the ball bearing contact face in the cover. A tilted oil seal is in nearly all cases responsible for oil leaks.

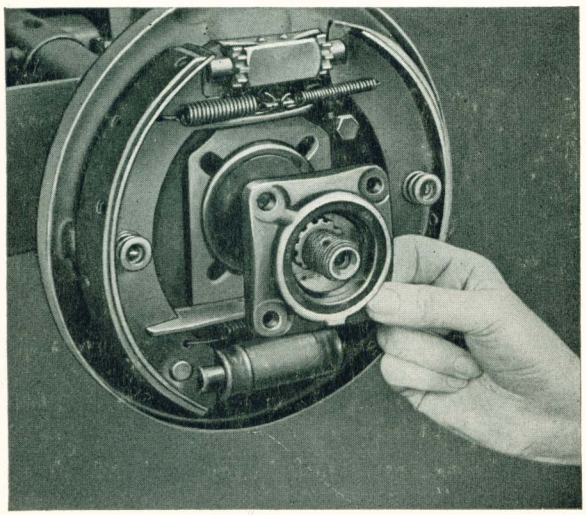


Installation

1 - Examine condition of ball bearing, renew if worn or damaged.

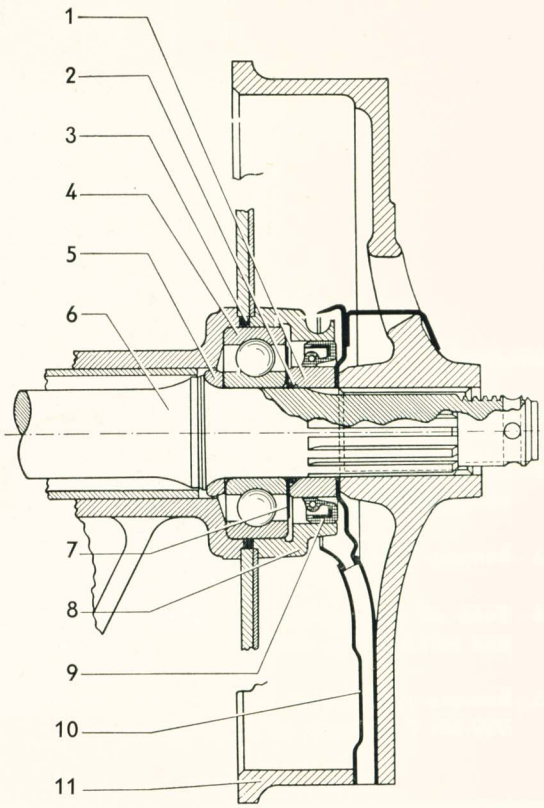
2 - Renew the two gaskets.

3 - Replace cover so that the oil drip nose points downwards.



4 - The spacer must not be scored, cracked nor show signs of rust. To avoid damage to the oil seal lip by friction, the spacer should be lightly coated with oil. Make sure that all components to be fitted are absolutely clean.

5 - Clean the oil deflector before reinstalling it. Make sure that the oil drip tube is tightly bearing against the brake drum to prevent it fouling the brake shoes.



1 - Outer spacer
2 - Gasket
3 - Gasket
4 - Ball bearing
5 - Inner spacer
6 - Axle shaft
7 - Washer
8 - Bearing cover
9 - Oil seal
10 - Oil deflector
11 - Brake drum

6 - Check splines in brake drum hub. Replace brake drum if splines are worn.

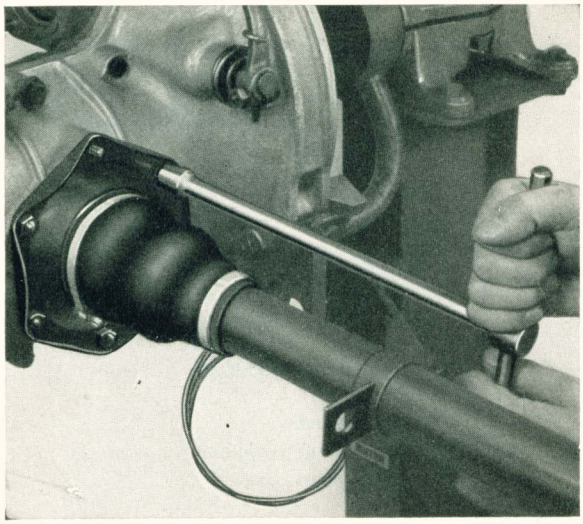
7 - Tighten rear axle shaft nut with VW 118/30 and VW 163 a (28—31 mkg/202—224 ft. lbs.) and secure it with a cotter pin.

Removing and Installing Rear Axle Tube

Removal

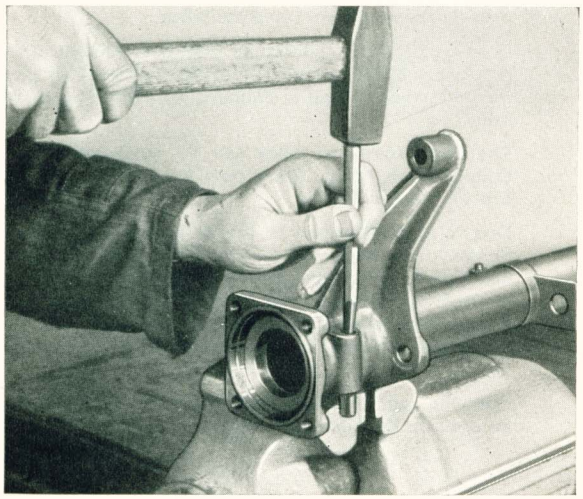
1 - Remove brake drum and brake back plate. Pull off rear wheel ball bearing.

2 - Remove nuts holding axle tube retainer.

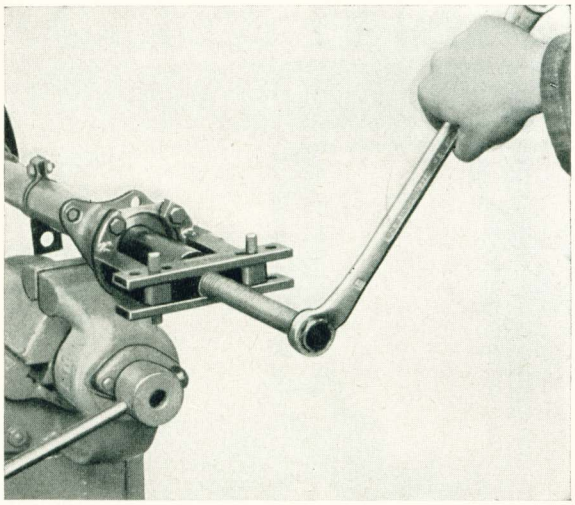


3 - Take off rear axle tube, retainer, and gasket.

4 - Drive out lock pin in axle shaft bearing housing.



5 - Remove bearing housing from axle tube by using extractor VW 202 in conjunction with VW 202b and VW 202h or Repair Press VW 400 in conjunction with VW 407 and VW 401.



Note:

Bearing housings become generally bent or damaged when removing them in an unskilled manner and tend to crack when attempting to straighten them. Damaged bearing housings should not be reused.

6 - Take off brake cable retaining ring (rubber).

7 - Release dust sleeve clips and withdraw dust sleeve and axle tube retainer from axle tube.

Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

1 - Clean axle tube retainer and axle tube retainer seat on transmission case.

2 - Check convex axle tube seating surface on transmission case for wear. If burr is present, remove it with a scraper.

3 - Examine dust sleeve; renew if damage is apparent.

4 - Install brake cable retaining ring (rubber).

5 - Inspect axle shaft bearing housing; renew it if damage is apparent. Before pressing the housing in place, thoroughly clean all seating surfaces and oil both, housing and axle tube. Press the housing in place by using Repair Press VW 400 in conjunction with VW 407 and VW 433. With the axle tube in position, the bearing housing should be installed with the drift VW 240a.

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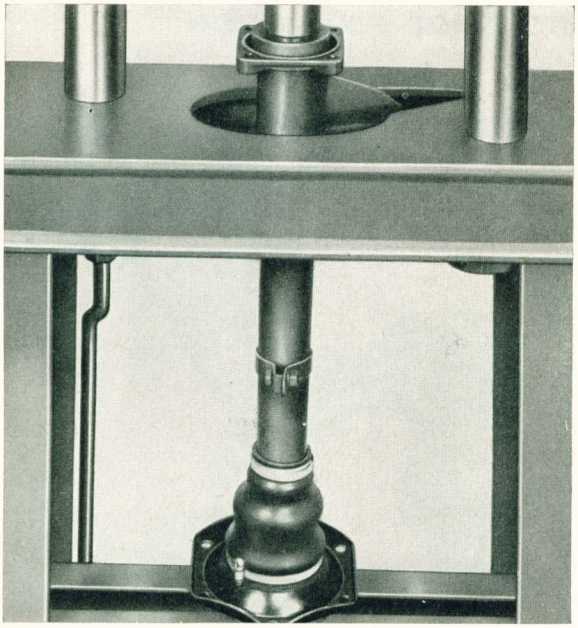
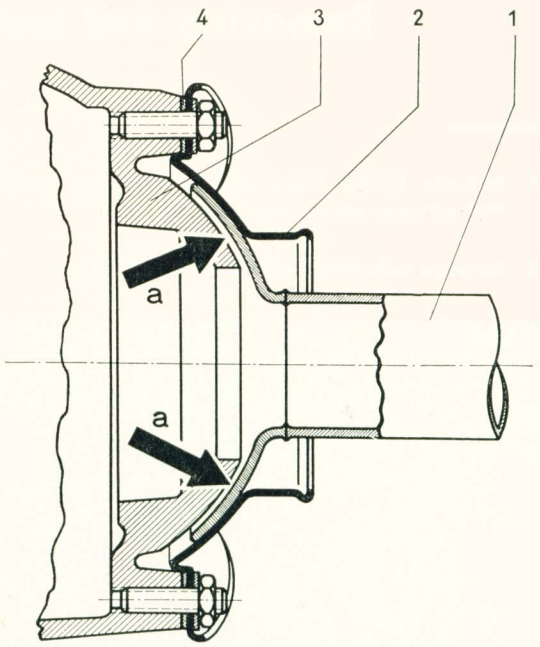




a = max. 0.7 mm (0.028″)

1 - Rear axle tube
2 - Rear axle tube retainer
3 - Transmission case
4 - Gasket

6 - Check end play of axle tube (0.40—0.60 mm /0.016″—0.024″). If the wear limit of 0.7 mm (0.027″) es exceeded (source of noise), the prescribed play can be restored as follows:

The oil resistant paper gasket (0.25—0.30 mm /0.01″—0.012″) under the axle tube retainer should be removed or replaced by another one of 0.1—0.15 mm (0.004″—0.006″). If no paper gasket is fitted, the axle tube retainer must be coated with sealing compound.

Note:

The above described reduction of the axle tube end play can also be carried out with the rear axle in situ.

7 - Tighten dust sleeve clips not before the rear axle is installed to prevent the dust sleeve from becoming twisted and eventually damaged.

Note:

During the period from the end of March to the beginning of October 1957, from Chassis No. 1673351 rear axle tubes were fitted in a number of cases which were not ground at the bearing flange seat but were in an unmachined condition.

If on occasion of repairs an unmachined axle tube is to be replaced by a ground tube, a new bearing flange has to be used in conjunction with the ground tube.

The two rear axle tubes can be easily identified. Only ground, tubes, spare part number 111501105, are supplied as spares.

Due to a modification in the design of the bearing flange, ring gauge VW 433a has to be used, in addition to pressure plate VW 433, when pressing the bearing flange on the axle tube. Only thus can a proper seat be ensured between the flange bore for the dowel pin and the flat section of the rear axle tube.

With the rear axle installed, mandrel VW 204a can be used on the bearing flange.

Renewing Rear Axle Dust Sleeve

(With rear axle in place)

To avoid a removal or disassembly of the rear axle when renewing a damaged dust sleeve, a split dust sleeve is available.

Important!

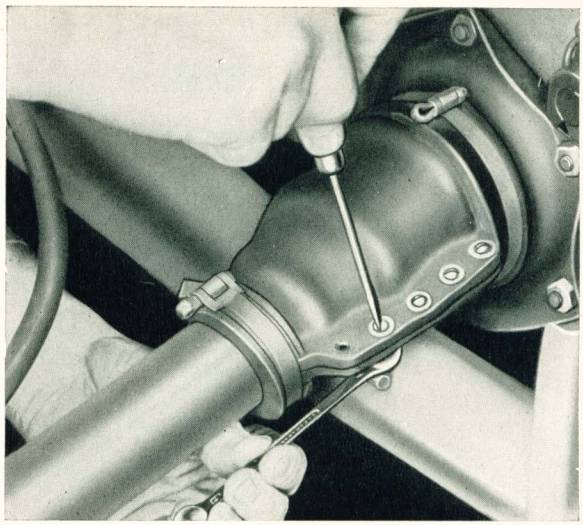
The dust sleeve screws and retaining clips should not be overtightened. Tightening should be done with the rear axle in loaded condition. Take care the dust sleeve is not twisted or strained.

Removal

1 - Remove both retaining clips.

2 - Cut and remove the dust sleeve.

3 - Clean axle tube and axle tube retainer.



Installation

1 - Slightly coat jointing faces of the split dust sleeve with elastic sealing compound (VW Sealing Compound D 1 a).

2 - The flange of the split dust sleeve should point horizontally towards the rear. Tighten screws.

3 - Tighten retaining clips (9 mm/0.35″).

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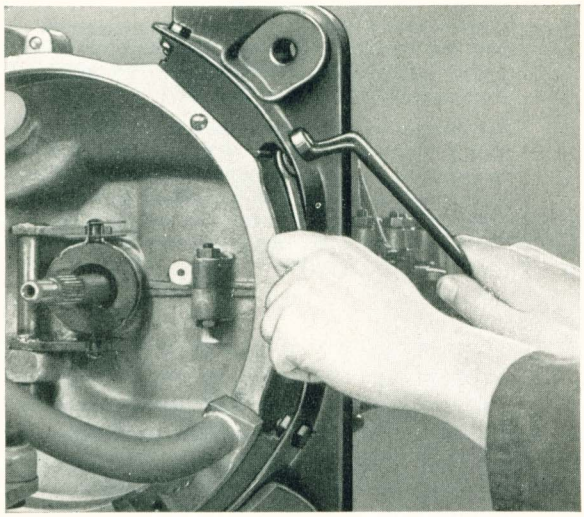
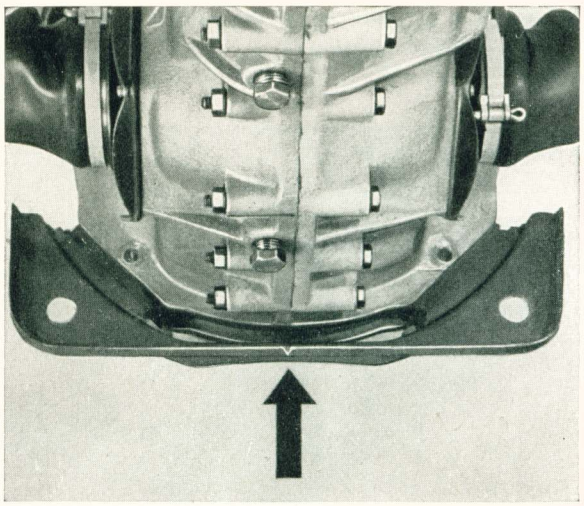
Removal and Installation of Transmission Carrier

Removal

1 - Remove the four screws that attach the transmission carrier to the rubber cushions.





2 - Withdraw transmission carrier.

3 - The removal of the two rubber cushions is only necessary when completely disassembling the rear axle. It is recommended to remove them not before the transmission case is opened.

Important!

An incorrectly mounted transmission carrier (note center mark) is responsible for an incorrect position of transmission and engine, leading to difficult hearshifting and insufficient sealing of engine compartment against road dust.

Note:

The following modifications on the transmission mounting cushions were introduced with Chassis No. 1—0713985 to improve the sound insulation of the body:

1 - Front rubber cushion:
Softer than before.

2 - Rear rubber cushion:
Harder than before.

Installation

Installation is a reversal of the preceding operations, but the following points should be heeded:

1 - Inspect rubber cushions for damage.

2 - Attach transmission carrier to rubber cushions. The nuts should, however, not be tightened before the transmission is installed and the nuts of the front rubber cushion are tightened. Care should be taken that the center mark on the carrier is in line with the transmission jointing faces.

Hints for subsequent installation

a - The altered parts are marked by a yellow paint line. Additionally, an "A" is indented in the rubber or raised.

b - Always a complete set (one front and two rear rubber cushions) should be used. The installation of old and new type rubber cushions in one car involves disadvantages.

c - After the altered rubber cushions have been installed, make sure that the clutch cable guide tube bends down at least 30 mm (1.2″). This tension of the guide tube is obtained by inserting washers Part No. 11 513 399 between the bracket at the transmission and the end piece of the guide tube.

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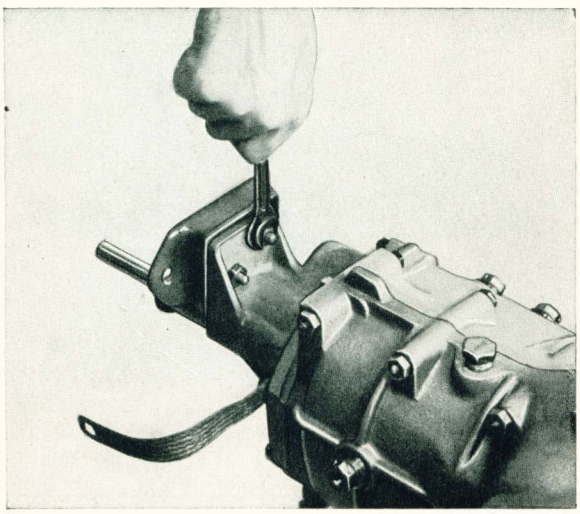
Removing and Installing Gearshift Housing

Removal

1 - Remove nuts that attach the rubber cushion to the gearshift housing.



2 - Remove gearshift housing nuts and take off ground strap.

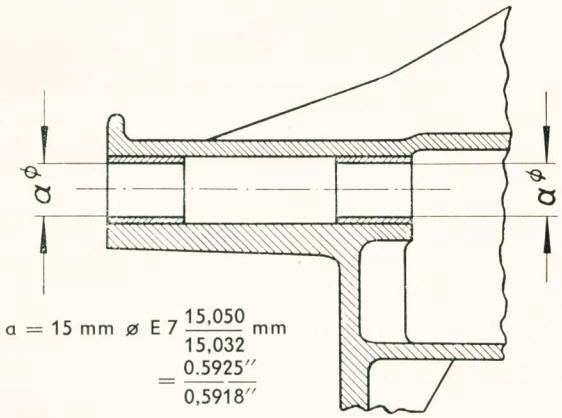
3 - Take off gearshift housing and transmission shift lever.

4 - Remove gasket and clean jointing faces.

Installation

This is accomplished by reversing the removal procedure, but the following hints should be observed:

1 - Inspect transmission shift lever bushes. Worn bushes must be replaced by using the Repair Press VW 400 in conjunction with VW 401, 412, and 439. The bushes are to be reamed up to $\frac{15.050}{15.032}$ mm $= \frac{0.5925''}{0.5918''}$.



Note:

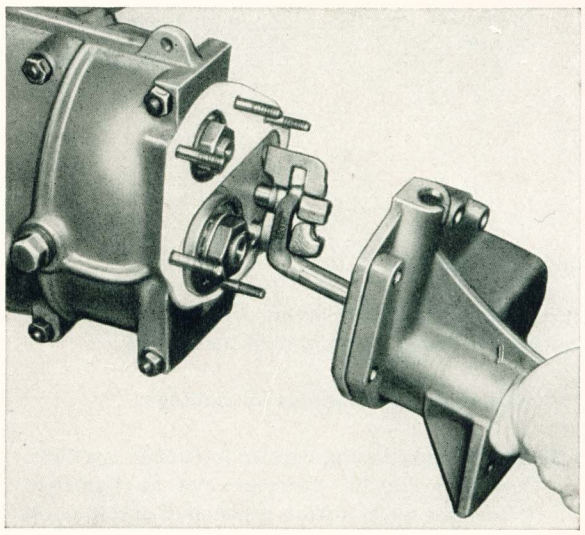
From Chassis No. 1—0881293 onwords, one transmission shift lever is used for both synchromesh and standard transmissions in lieu of the two different levers.

If necessary, the new transmission shift lever can be subsequently installed in synchromesh and standard transmissions built after January 1953 — approx. from Chassis No. 1—0428157 onwards. The gearshift housing of these transmission has its inner edges chamfered in a way which allows proper gearshifting with the new lever. The new lever does not allow a proper engagement of the reverse when installed in transmissions built before Dec. 1952.

For earlier standard transmissions, the transmission shift lever, is still available as a spare part. Should it become necessary to replace levers of synchromesh transmissions built during the period from October 1952 (introduction of synchromesh) to December 1952, this should be done in conjunction with the corresponding gearshift housings.

2 - Note thicknesses of gasket and paper ring between gearshift housing and transmission case to insure that the ball bearings are correctly preloaded. Excessively preloaded ball bearings may cause noise and premature wear. Only use gaskets which cover the hole for the reverse sliding gear shaft.

3 - Make sure the three selector shafts are in neutral position when attaching the gearshift housing.



4 - Connect ground strap to the correct stud.

Preload of Transmission Ball Bearings

General

The assembly of the transmission case necessitates a careful consideration of the preload on the drive pinion double row bearing and the main drive shaft front bearing.

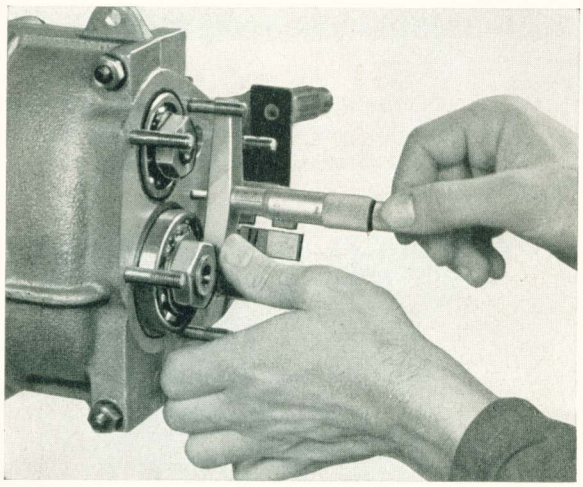
The gearshift housing is tightened in position to a preload of between 0.02 and 0.11 mm (0.0008″ and 0.0043″). The preload is obtained by the correct selection of the gasket or paper ring.

How to Determine Preload

Before measuring, any end play of the drive pinion and main drive shaft should be eliminated by light taps with a mallet. The measuring should, if possible, be done with a depth micrometer.

The following dimensions should be checked:

a - Dimension D, distance from matching face of transmission case to drive pinion bearing face.



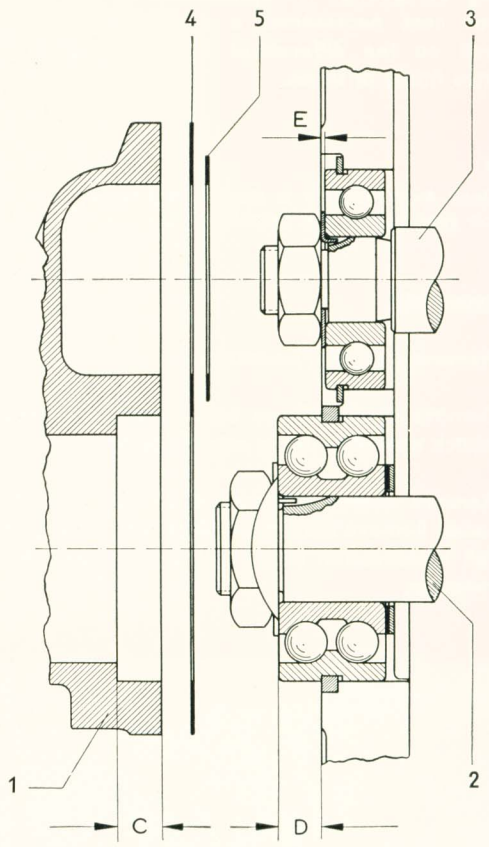
Dimension C, depth of recess for drive pinion bearing in gearshift housing.

The difference between D and C is to be compensated by the selective fitting of the gasket and paper ring to insure the prescribed preload (0.02—0.11 mm/0.0008″—0.0043″) on the double row ball bearing.

b - Dimension E, distance from matching face of transmission case to main drive shaft bearing face.

This bearing must be subject to the same preload as the double row ball bearing. A selection of paper rings (5) is available to correct the preload on the main drive shaft bearing.

These rings are to be glued to the gasket (4), taking care that they are concentric with the ball bearing.



1 - Gearshift housing
2 - Drive pinion
3 - Main drive shaft
4 - Gasket
5 - Paper ring

C - Depth of recess for double row ball bearing in gearshift housing.
D - Distance from transmission case matching face to double row ball bearing face.
E - Distance from transmission case matching face to main drive shaft ball bearing face.

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Example:

a - Dimension D	10.50 mm
Dimension C	10.25 mm
Difference	0.25 mm
Dimension for preload	— 0.05 mm
Thickness of gasket	0.20 mm

b - Dimension E	0.14 mm
Preload on main drive shaft ball bearing	+ 0.06 mm
Thickness of paper ring	0.20 mm

Disassembly and Assembly of Transmission Case

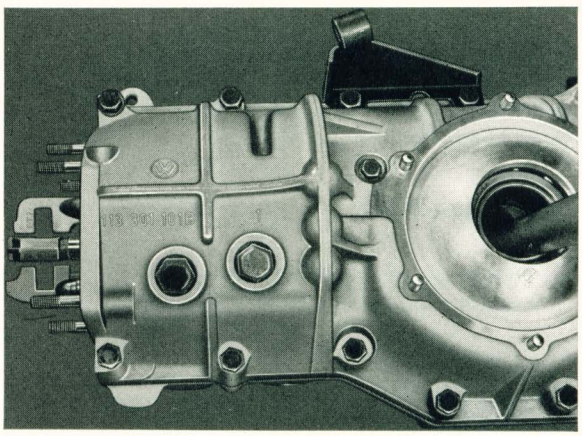
The two transmission case halves are machined in pairs to very close limits and in consequence replacements must be made in pairs. It is not necessary to replace the gearshift housing together with the transmission case. After the matching faces have been cleaned, they must be lightly coated with sealing compound. A replacement of the transmission case necessitates a readjustment of the preload on the differential ball bearings by a selective fitting of shims.

Note:

The Rear Axle Number is stamped on the right transmission case half at the gearshift housing jointing face.

Note:

From Chassis No. 1600440 the stud near the axle tube retainer has been discarded and is replaced by a protuding bolt. Due to the smaller diameter of the needle bearings for drive pinion and drive shaft the bolt could be housed in the web between bearings.



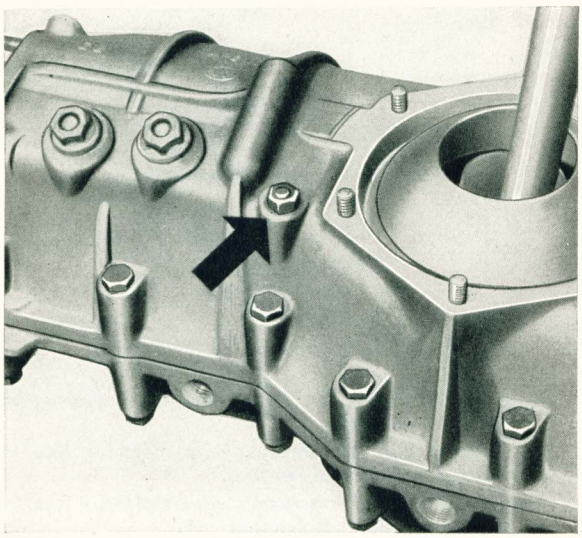
Disassembly

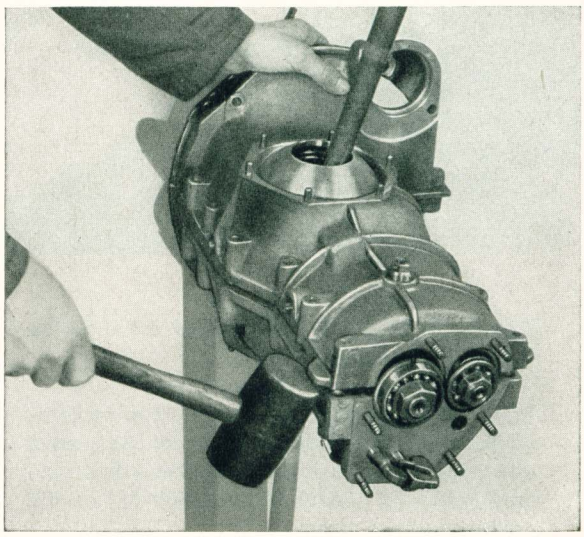
1 - Remove gearshift housing.

2 - Remove clutch release bearing and disconnect clutch operating lever return spring.

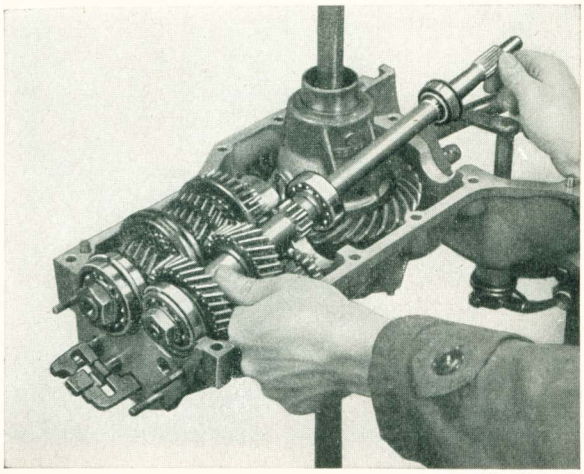
3 - Remove screws at transmission case matching faces. Remove the nut on the stud situated at the left transmission case half near the axle tube retainer.

4 - Turn the transmission case and take off right transmission case half, taking care not to damage the jointing faces.



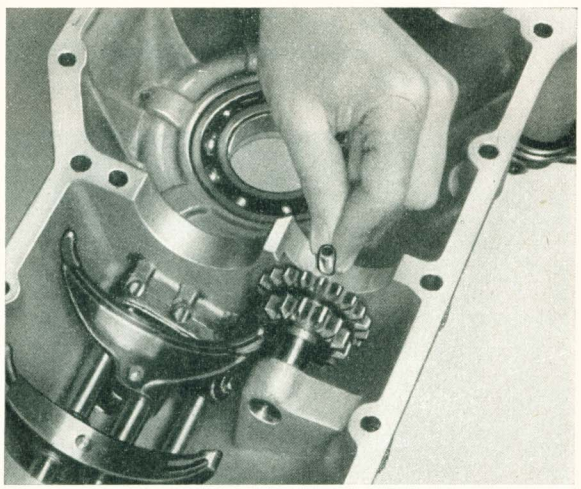


5 - Remove complete main drive shaft and drive pinion from left transmission case half.

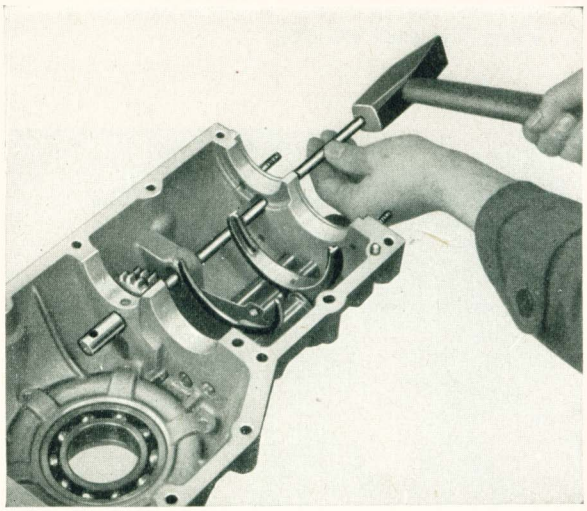


6 - Drive out differential and rear axle shafts from the left transmission case half by means of a mallet. Note arrangement of the differential shims to assure proper installation at assembly.

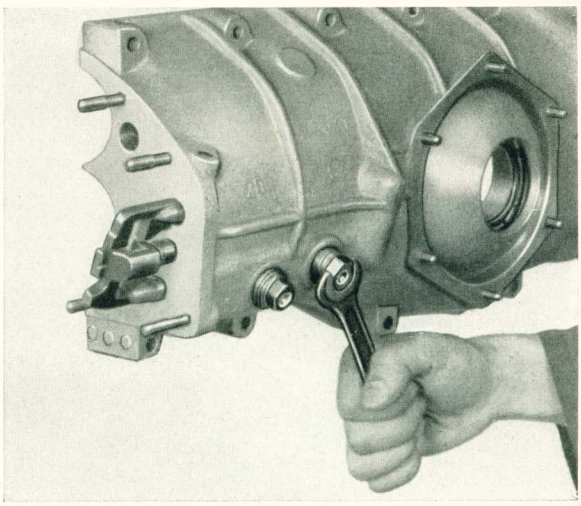
7 - Remove lock pin at reverse sliding gear shaft.



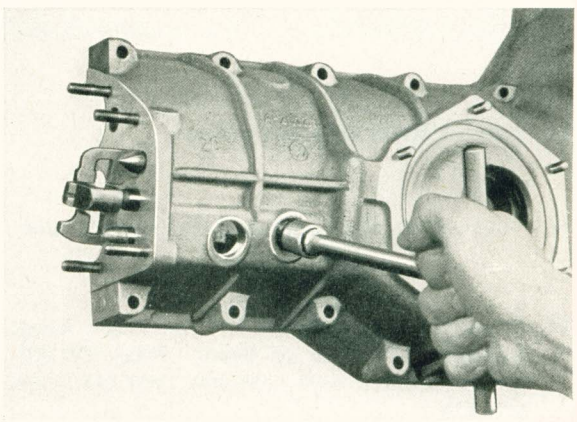
8 - Drive out reverse sliding gear shaft and remove reverse slidning gear.



9 - Remove plug screws from the holes which give access to the selector fork locking screws.



10 - Loosen locking screws of first-and-second selector fork and third-and-fourth selector fork, using hex. socket wrench 11 mm.



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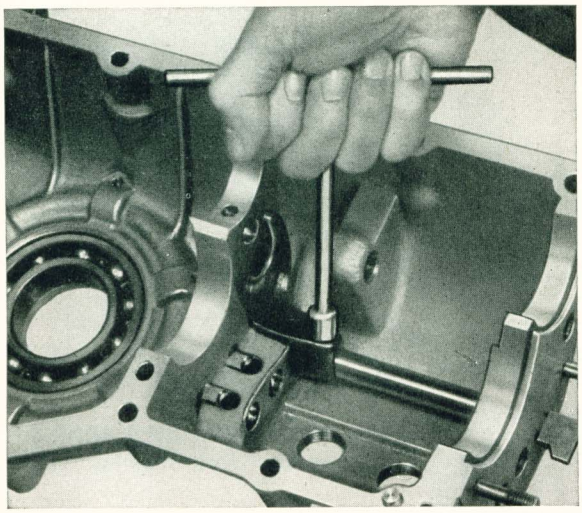
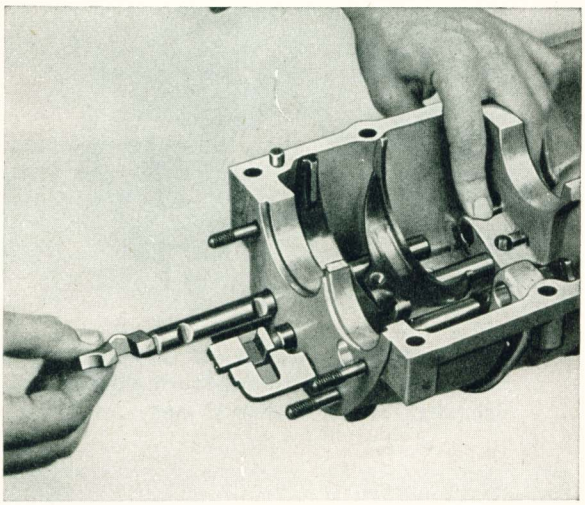
11 - Remove locking screw of reverse selector fork, using T-wrench VW 114.



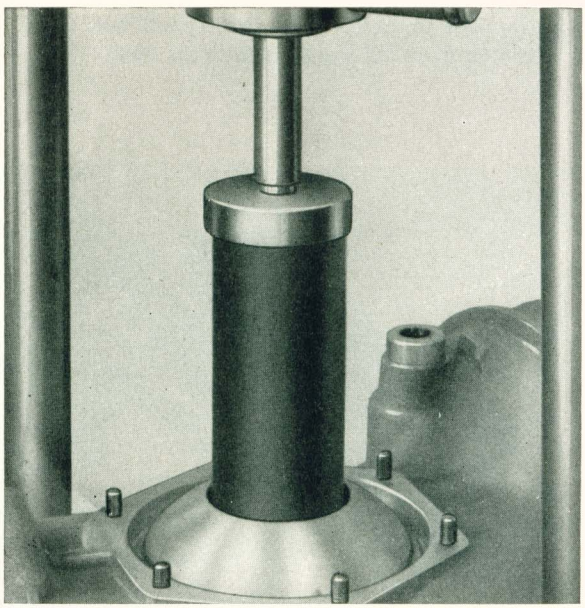
12 - Withdraw selector shafts. Prevent the detent balls jumping off by covering the holes. Remove selector forks.



13 - Remove detent balls and springs.

14 - Take off the two selector shaft interlock pins.

15 - Remove the differential ball bearings, using extractor VW 290b or Repair Press VW 400 in conjunction with VW 409, VW 415, and VW 433.



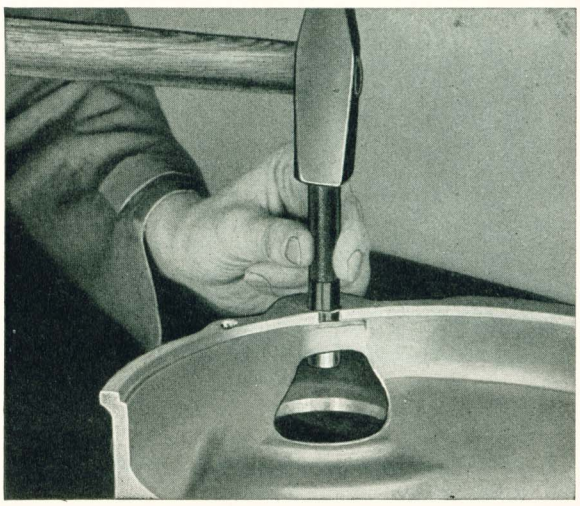
16 - Remove clutch operating shaft and lever, return spring and return spring seat.

Assembly

This is effected by reversing the preceding operations, but the following points should be noted:

1 - Thoroughly clean transmission case and check for wear, external damage and cracks. In the case of the drive pinion or ring gear (crown wheel) being damaged (e. g. breakage), check the bores in the transmission case webs for alignment; replace transmission case if necessary.

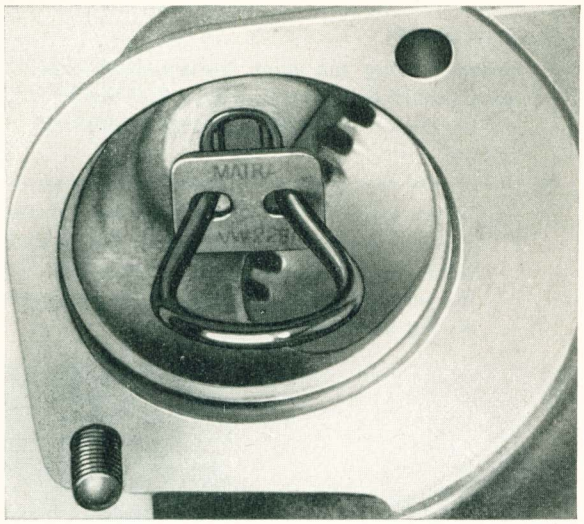
2 - Check starter shaft bush for wear, using plug gauge VW 246. If necessary, replace the bush by means of drift VW 222 or Repair Press VW 400 in conjunction with VW 401, VW 408 and VW 438.



Note:

Replacement of starter shaft bush with engine in situ:

Removal with extractor ..... VW 228a
Installation with drift ..... VW 222

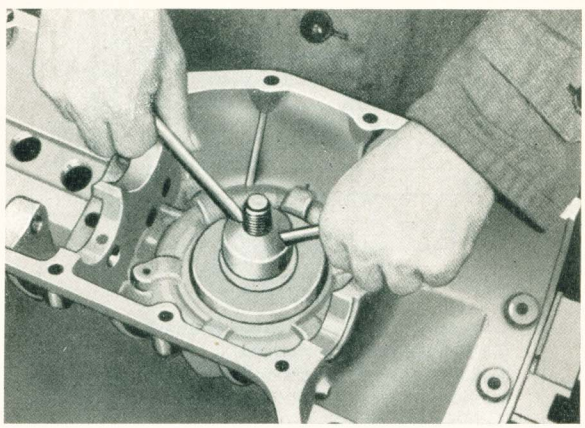


3 - Check clutch operating shaft bushes for wear, replace as necessary.

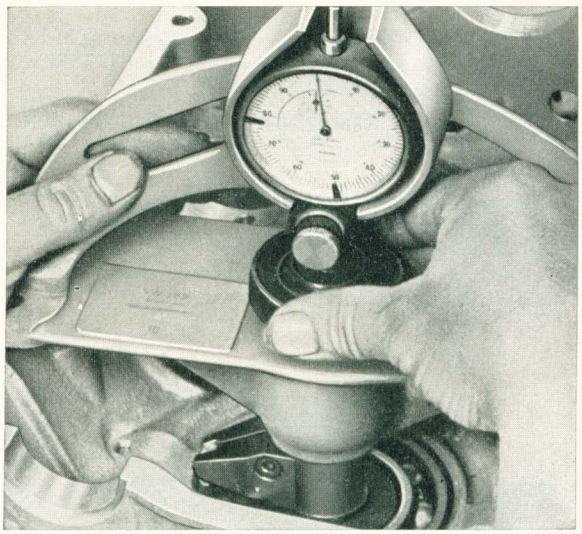
Important!

The clutch operating shaft must in all cases be installed before the transmission case halves are screwed together.

4 - Press the differential ball bearings in place, using Special Tool VW 290a or Repair Press VW 400 in conjunction with VW 401, VW 409, VW 415 and VW 433.



Check square seating of ball bearings by means of gauge VW 285, the permissible tilt being 0.02—0.04 mm (0.0008″—0.0016″).



5 - Examine reverse sliding gear bush and reverse sliding gear shaft; if necessary, replace.

Note:

The lubrication of the reverse sliding gear has been changed from Chassis No. 1216555 in the following manner:

1 - Both oil holes are no longer between the teeth of the reverse sliding gear, but at the base of the annular groove for the selector fork.

2 - The bronze bushing has been discarded.

3 - The new bushing made of "Main" metal is supplied with an inner annular groove and is completely smooth at the diameter of the press fit — with the exception of two fair sized oil holes which must register with the oil passages in the gear.

Caution!

If the new type reverse sliding gear is to be installed in earlier cars, be sure to take notice of the following: Because of the oil holes in the annular groove of the reverse sliding gear, the upper end of the selector fork must be round. Any edges should be rounded off.

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Note:

The lubrication of the reverse sliding gear has been altered from Chassis No. 1473411.

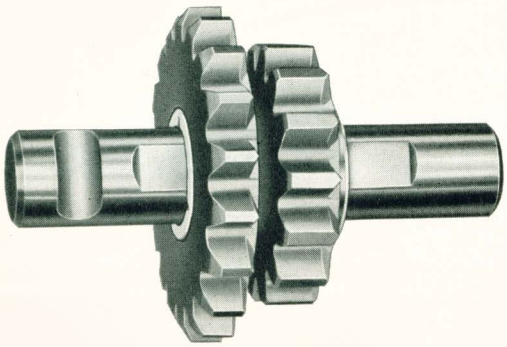
1 - The two oil passages in the annular groove of the reverse sliding gear for the selector fork have been omitted.

2 - The shaft for the reverse sliding gear has been provided with a flat side on the sliding surface. (Part No. 113309515 A).

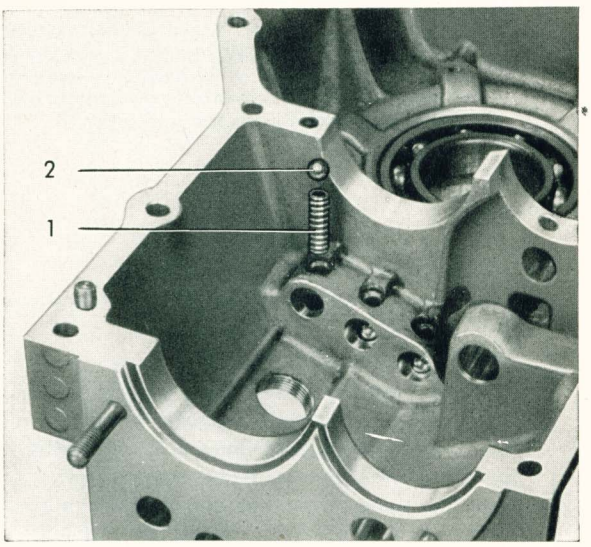
3 - The two oil passages and the annular lubrication groove in the "Main" metal bush have been omitted.

The modified reverse sliding gear must be installed in conjunction with the modified reverse sliding gear shaft provided with a flat side.

The Part No. 113309501 A for the reverse sliding gear with bush remains the same.



6 - Examine detent springs and replace as necessary. Free length of detent spring: 25 mm (1″); wear limit: 23 mm (0.9″). The force applied to overcome the detent ball undercuts on the selector shafts should amount to approx. 15—20 kg (35—45 lbs.). A test should be carried out with the drive pinion removed, if difficult gear shitting is experienced.



1 - Detent spring 2 - Detent ball

7 - Install and secure selector shafts and forks in the following order:

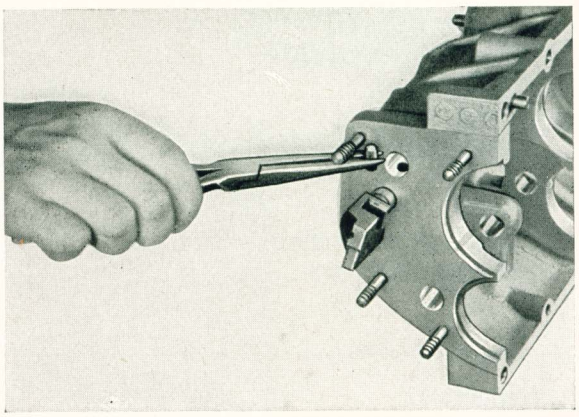
a - Install and secure selector shaft and fork for reverse gear.

b - Secure reverse sliding gear shaft.

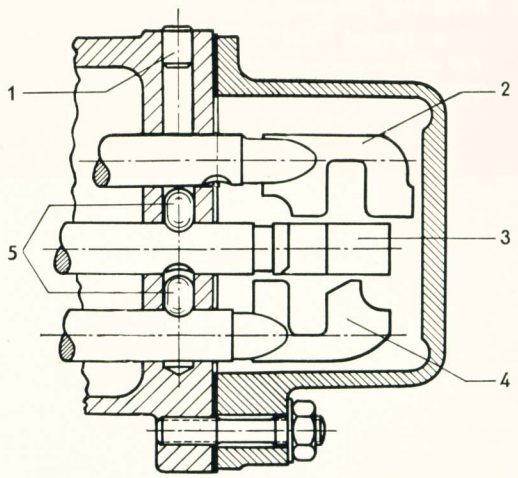
Important!

When turning the open transmission case, care should be taken to insure that the lock pin for the reverse sliding gear shaft does not fall out.

c - Install selector shafts and forks for 1st and 2nd and for 3rd and 4th gears, taking care not to omit the two interlock plungers. Screw the selector fork locking screws in place, but do not yet tighten them.



Check for proper interlocking by engaging a gear. The selector shaft next to the one used must be locked. When engaging 1st or 2nd gears (center selector shaft), the two other selector shafts should be locked.



1 - Plug for interlock plunger channel
2 - Selector shaft for reverse
3 - Selector shaft for 1st and 2nd gears
4 - Selector shaft for 3rd and 4th gears
5 - Interlock plungers

8 - Check selector forks for wear. The clearance between selector fork and operating sleeve or 1st gear should not be in excess of the specified limits. Replace worn parts should the necessity arise.

9 - Inspect differential and replace worn or damaged components.

Note:

The differential housing, cover, and ring gear retaining screws were modified with effect from Chassis No. 1—557124 for a better lubrication of the fulcrum plates. Introduced at the same time was the oil deflector plate that guides the oil to the differential housing apertures.

The deflector plate is attached to the clutch side of the transmission case by means of a hex. bolt M 8 x 20, the corresponding nut being welded to the plate. The bolt is secured in position by means of a copper lock plate.

This modification can be incorporated in earlier synchromesh transmissions as detailed in the "Technical Bulletin H 2".

Important!

The modified parts (differential housing, cover, and ring gear retaining screw)s are **not** interchangeable with those used on cars up to Chassis No. 1—557124.

When placing the differential in position, be sure the shims occupy their original positions.

Attention!

VW Passenger Cars:	Ring gear (crown wheel) in left transmission case half.
VW Transporter:	Ring gear (crown wheel) in right transmission case half.

10 - Inspect drive pinion, main drive shaft, and oil seal; replace worn or damaged parts.

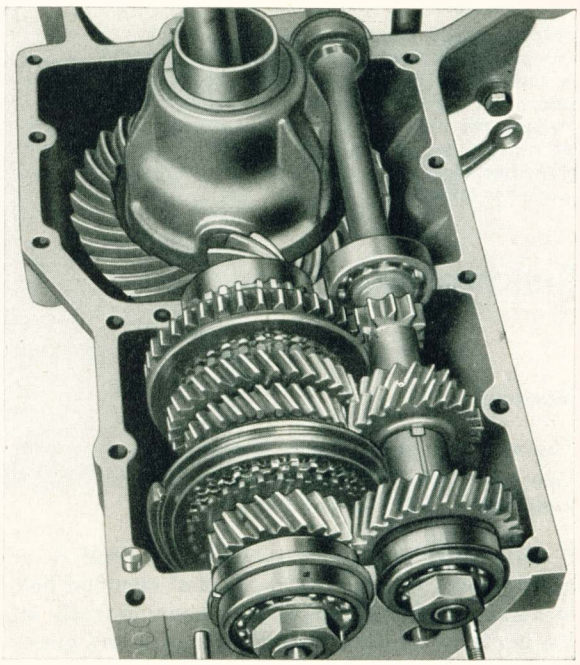
Oil the contact surface of the oil seal lip before sliding the oil seal on the main drive shaft. Care must be taken to see that the ball bearing retaining rings are bedding correctly in the provided ring grooves. Their gaps should be slightly above the jointing face of the left transmission case half. Lightly tap drive pinion and main drive shaft towards ring gear (crown wheel).

11 - Carefully adjust 1st-and-2nd selector fork and 3rd-and-4th selector fork as follows:

a - The 1st-and-2nd selector fork should be carefully positioned to insure that the 2nd and the 1st gears correctly engage when carrying out a shifting control. If found that the 2nd gear only engages partly, the selector fork should be positioned closer towards the 2nd gear.

b - The 3rd-and-4th selector fork should be positioned to insure that both gears engage the same amount. Departures from that position should be corrected after a shifting control to assure a proper functioning of the synchro unit.

c - After the selector forks have been positioned, the locking screws should be tightened to a torque of 2.5 mkg (18 ft. lbs.), using torque wrench VW 118 in conjunction with 11 mm hex. socket.



12 - Plug up the two adjusting holes in the transmission case.

13 - Before attaching the transmission case halves, check gearshifting and proper meshing of all gears.

14 - Clean all jointing faces and oil seal seatings and lightly coat them with Sealing Compound D 1 a.

15 - Tighten transmission case screws in the below indicated order to a torque of 2 mkg (14.5 ft. lbs.).

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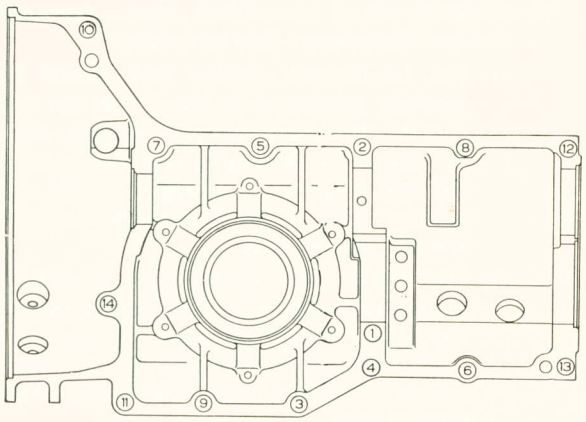
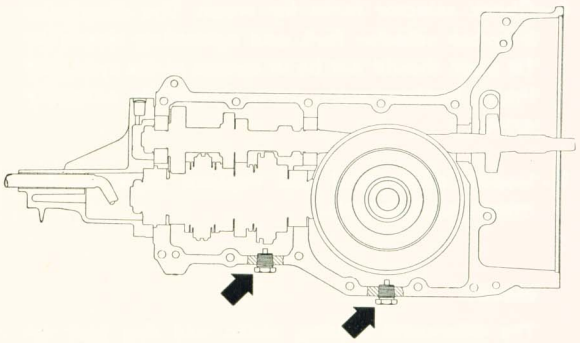


16 - Connect clutch operating lever return spring.

Note:

Two magnetic oil drain plugs are recommended for use in cases where new car owners are known to be lacking experience and practice in operating a car, so that improper gear shifting can be expected (e. g., shifting down to first without double declutching, or engaging reverse before the car has come to a dead stop). Such practice involves the risk of metal chips breaking off the gear teeth edges and getting lodged between balls and races of the bearings, which are then bound to develop a noise sooner or later.



To make the magnetic plugs fully serve their purpose, they should, if possible, be installed before the customer takes delivery of the car. Experience has shown that metal chips will occur especially during the first few hundred miles of operation on account of abrasion and clash when shifting in an unskilled manner.

Maintenance

Cleaning the plugs at prescribed intervals is essential, as the permanent magnets can hold only a limited amount of foreign matter.

Intervals

After 500 km (300 miles), 2,500 km (1,550 miles), 5,000 km (3,000 miles), and then every 5,000 km (3,000 miles).

Note:

From August 1957 the oil drain plugs have been moved from the center to the ends of the transmission case where oil impurifications can collect which are flushed out when draining the oil.

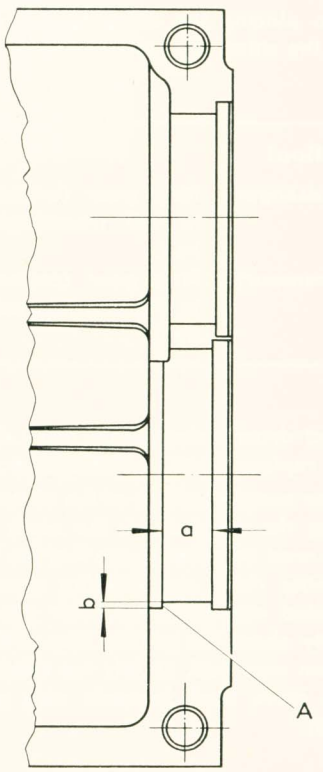
Synchromesh Transmission — Replacing 3rd and 4th Gear Wheels

(December 1957)

General

The modified gear wheels for 3rd and 4th speed (spare part nos. 113 309 275 A and 113 309 341 A) have tooth ratios of 23 : 28 and 28 : 23.

If these wheel pairs are subsequently fitted in a transmission of older design, special attention has to be paid to the 4th speed gear running freely at the partition between transmission case and gear-shift housing when the pinion assembly has been put in place and the case is still open. If necessary, the case has to be reworked at the spot indicated (A).

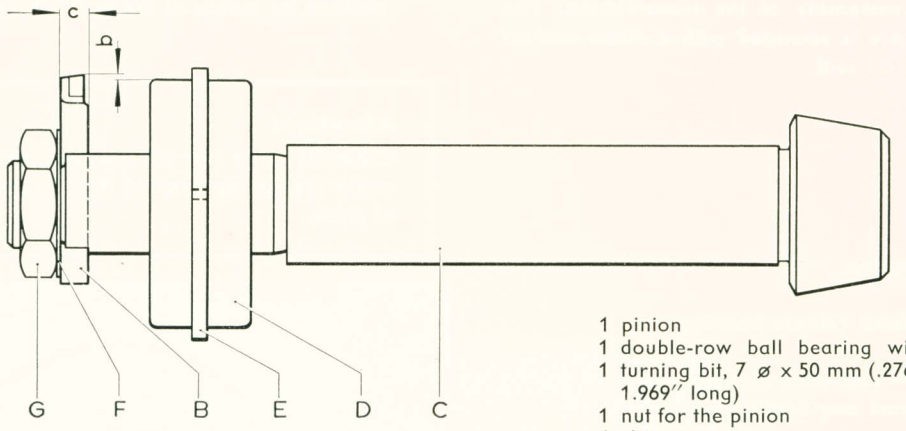


The following dimensions have to be complied with:

a = 12 mm (.472″)
b = 1.5 mm (.059″)

Requisite tools

The transmission case can be reworked by using a turning tool which can be manufactured from a few worn parts at any workshop. For this purpose you will need:



1 pinion
1 double-row ball bearing with lock ring
1 turning bit, 7 ø x 50 mm (.276″ dia, 1.969″ long)
1 nut for the pinion
1 shim

Reduce the pinion diameter at the seat for the double-row ball bearing until the bearing can be easily slid on by hand.

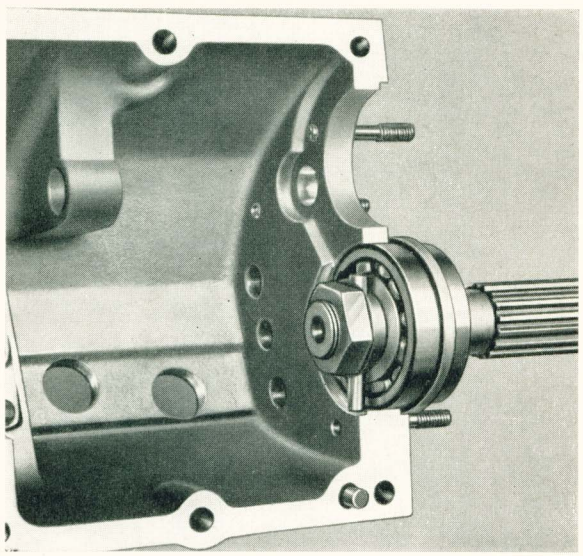
Now, use a cylindrical bit of 0—7 mm (0—.276″) diameter to drill into the pinion a hole for the accommodation of the turning bit, as shown on the drawing. Fit the turning bit into this bore and lock it into position by means of a shim and the pinion nut so that the cutting edge extends 1.5 mm (.059″) beyond the outer race of the double-row ball bearing.

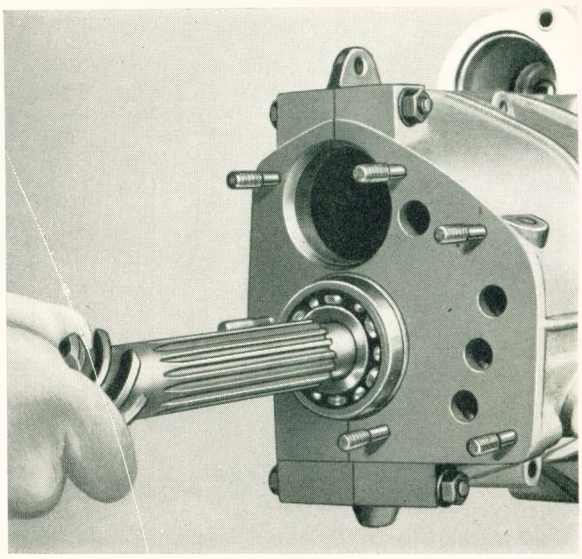
Reworking the transmission case

Place the turning tool into the open transmission case so that the pinion and the bevel gear which serve as a handle protrude from the case. Then fit the other half of the case and secure it by means of two hex. head screws.

Rework the two case halves by turning the pinion by hand.

As soon as the turning tool is available, the job can be completed within about ten minutes.





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Replacing Main Drive Shaft Oil Seal

(With rear axle in situation)

The oil seal permits a replacement without a removal and disassembly of the transmission. The transmission case is provided with a plane contact surface for the oil seal.

Removal

1 - Remove engine.

2 - Remove clutch release bearing.

3 - Remove oil seal from transmission case, taking care to avoid any damage.

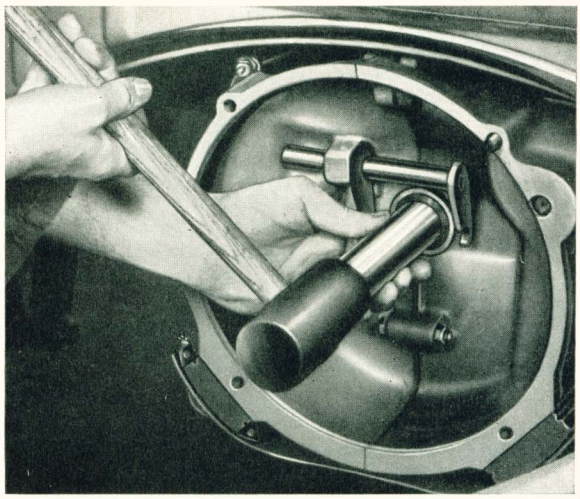
Installation

This is a reversal of the above operations, but the following points should be noted:

1 - Lightly coat the exterior of the oil seal with sealing compound. Oil main drive shaft and oil seal lip.

2 - Slide oil seal on main drive shaft and drive it in position by means of the tool VW 291 b.

Attention!
Carefully slide the oil seal on the shaft to avoid the spring around the lip coming out of place.



Oversize Transmission Case Studs

The tapped stud holes in the transmission case may become damaged due to overstraining, or some other reason, leading in some cases to oil leaks.

It is then permissible to re-tap the holes 2 mm oversize. To ensure a correct sealing, the thread should be cut, however, to the following unorthodox dimensions:

Female Thread in Transmission Case			
Nominal Size	Major Diameter (mm)	Pitch Diameter (mm)	Minor Diameter (mm)
M 8	7.630—7.705	7.188—7.300	6.416—6.731
M 10	9.616—9.698	9.026—9.138	8.097—8.452

The following drills must be used for boring the holes:

6.7 mm drill for thread M 8
8.4 mm drill for thread M 10

The threads are cut by single thread machine taps (DIN 376), the outer diameters of which should be ground down to the following dimensions (VW Works Norm ZN 7038):

Taps			
Nominal Size	Major Diameter		
	Low Limit (mm)	High Limit (mm)	Permissible Wear up to (mm)
M 8	7.660	7.680	7.630
M 10	9.640	9.660	9.616

The corresponding studs, which are oversize at the end to be screwed into the transmission case, can be obtained as spare parts.

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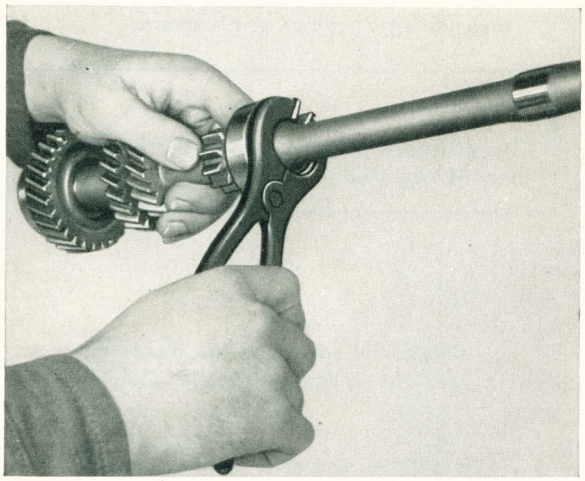
Reconditioning Main Drive Shaft

Disassembly

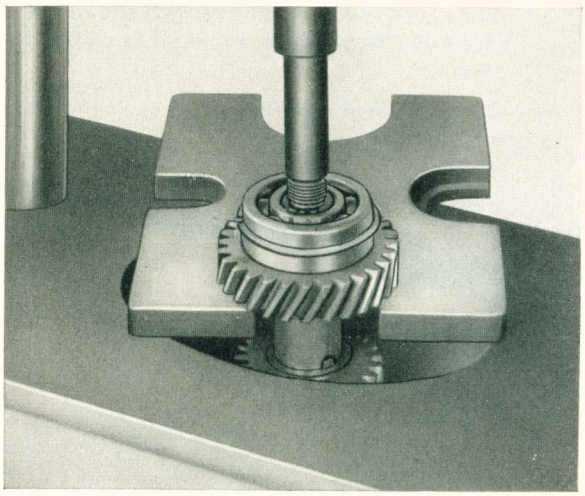
1 - Disassemble transmission case and lift out main shaft.

2 - Remove ball bearing retaining ring at first speed gear, using tool VW 161 a.

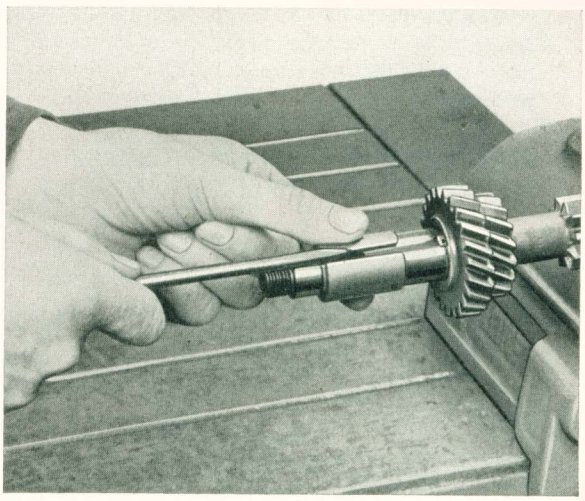


3 - Pry up lock plate and remove the nut by means of a 27 mm wrench.

4 - Remove fourth speed gear and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 408.



5 - Remove spacer between 3rd and 4th gear by means of a screwdriver.



6 - Remove third speed gear by means of the Repair Press VW 400 in conjunction with VW 401, 409, 421, and 431.

7 - Take off the keys in the main drive shaft.

8 - Remove ball bearing at 1st speed gear by means of Repair Press VW 400 in conjunction with VW 401 and 412.

9 - Clean the main drive shaft, especially its center holes.

Inspection

1 - Check main drive shaft for wear:

a - Check main drive shaft pilot for wear.

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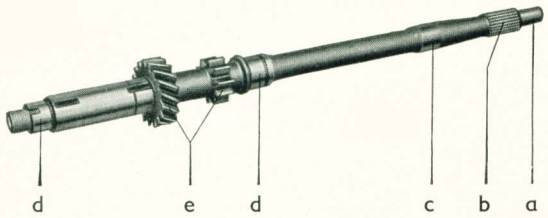
b - Check splines for wear (radial clearance).

c - Check oil seal seating for scores and signs of wear.

d - Make sure that the ball bearings and gears (3rd and 4th speeds) are a press fit on their seats.

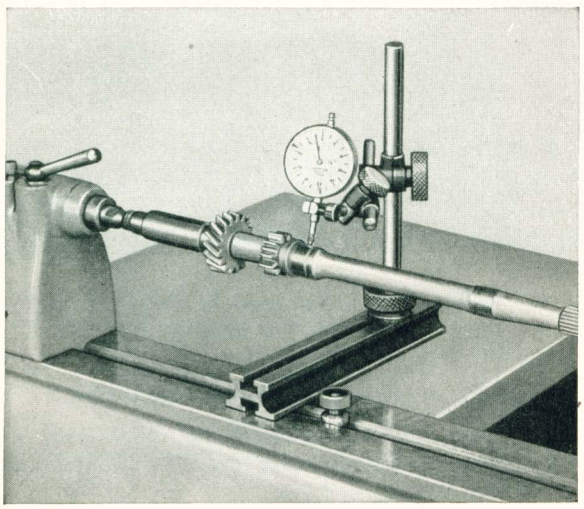
e - Check first and second speed gears for wear and damage.



a - Pilot
b - Splines
c - Oil seal seat
d - Seat (3rd and 4th gears)
e - Gears for 1st and 2nd speeds

Excessive wear, damage or excessive play necessitate a replacement of the main drive shaft. If the gears for the 1st and 2nd speeds are found to be excessively worn, the corresponding gears on the drive pinion shaft should also be replaced.

2 - Check main drive shaft for run-out. Place main drive shaft between two points and check at



intermediate seat. Permissible run-out: max. 0.05 mm (0.002″). If the run-out is in excess of this limit, the main shaft may be straightened in cold condition by means of Repair Press VW 400 in conjunction with VW 405 and VW 406.

Note:

With the main drive shaft installed in the transmission case, the run-out (max. 0.2 mm/0.008″) should be measured at the pilot.

3 - Inspect ball bearings for wear and damage, replace as necessary.

4 - Check third and fourth speed gears for wear and damage, replace as necessary.

Attention!

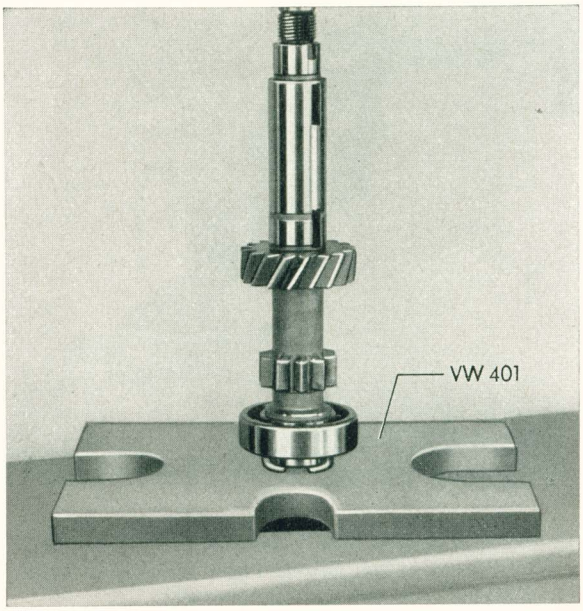
The gears for the third and fourth speeds must only be replaced in pairs.

Assembly

This is effected by reversing the disassembly procedure, but the following points should be observed:

1 - Press ball bearing at 1st gear in position, using Repair Press VW 400 in conjunction with VW 401 and 419.

2 - Press retaining ring for ball bearing at 1st gear in position, using Repair Press VW 400 in conjunction with VW 401 and 411 (use that side of the plate VW 401, on which the center hole is not countersunk). A good lubrication of main drive shaft and retaining ring should precede the above operation.



3 - Place the two keys in position.

Important!

Before pressing the gears and ball bearings in place, they must be heated to approx. 80 °C (180 °F) in an oil bath. Gears and ball bearings must be a press fit on the main shaft.

4 - Press 3rd gear in place, using Repair Press VW 400 in conjunction with VW 401, 412, 416, and 419.

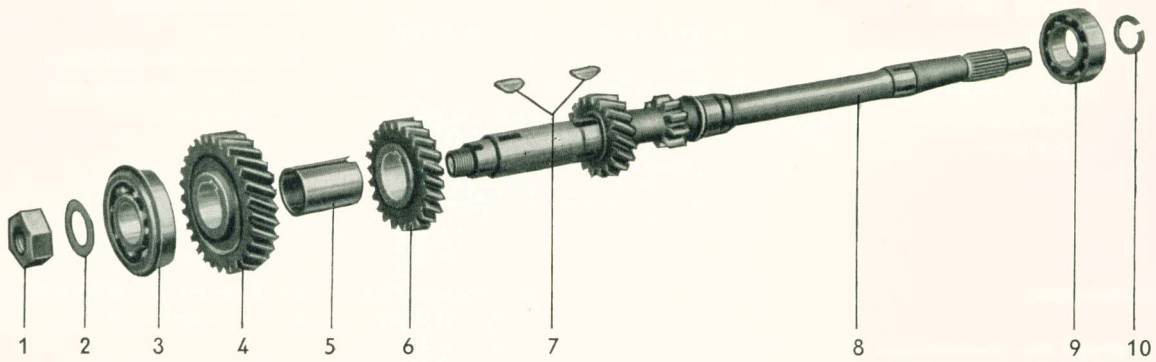
Care should be taken that the tube VW 416 clears the key when pressing.

The 3rd gear must tightly bear against the 2nd gear.

5 - Expand spacer by inserting a screwdriver in the slot and slide it on the shaft.

6 - Press 4th gear and then the ball bearing individually in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 420. When replacing the ball bearing do not forget to fit the retaining ring.

7 - Fit the lock plate so that the nose comes to rest in the slot which is cut in the main drive shaft. Tighten the nut by means of a hex. socket 27 mm and the torque wrench VW 118 to a torque of 3 mkg (22 ft. lbs.). Secure the nut with the lock plate.



1 - Hex. nut
2 - Lock plate
3 - Ball bearing and retaining ring
4 - 4th gear
5 - Spacer
6 - 3rd gear
7 - Keys
8 - Main drive shaft
9 - Ball bearing
10 - Retaining ring

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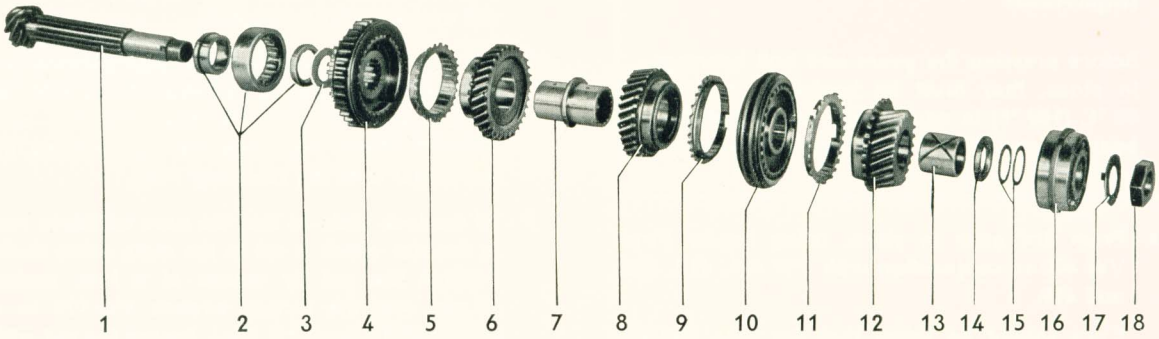
Reconditioning drive pinion



1 - Drive pinion
2 - Roller bearing
3 - Shim
4 - Clutch gear and 1st gear
5 - Synchronizer stop ring (2nd gear)
6 - 2nd gear
7 - Bush
8 - 3rd gear
9 - Synchronizer stop ring (3rd gear)
10 - Clutch gear and sleeve for 3rd and 4th gears
11 - Synchronizer stop ring (4th gear)
12 - 4th gear
13 - Bush
14 - Friction washer
15 - Shims
16 - Double row ball bearing and retaining ring
17 - Lock plate
18 - Nut

Disassembly

1 - Open the transmission case and lift out drive pinion.

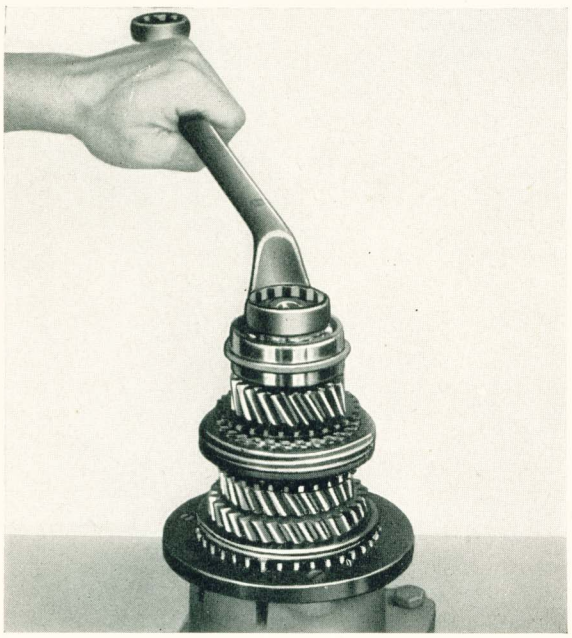
2 - Place drive pinion in holding fixture VW 314.

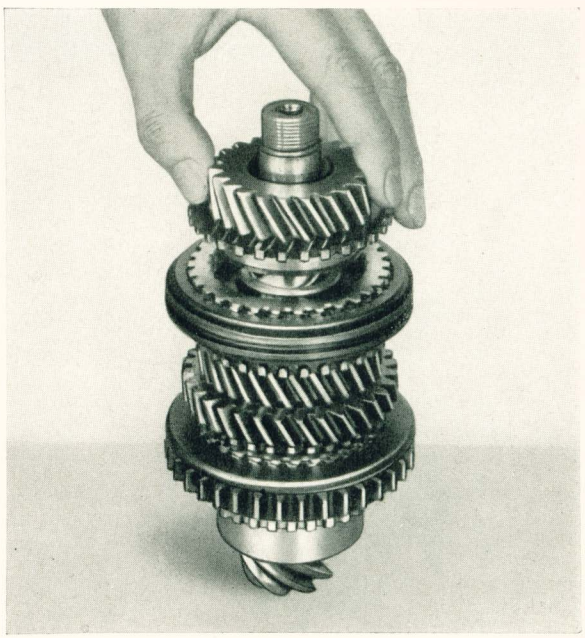
3 - Pry off nose of lock plate and screw off the nut.

4 - Remove double row bearing on Repair Press VW 400 in conjunction with VW 402 and VW 408.

5 - Take off shims and friction washer for 4th gear.

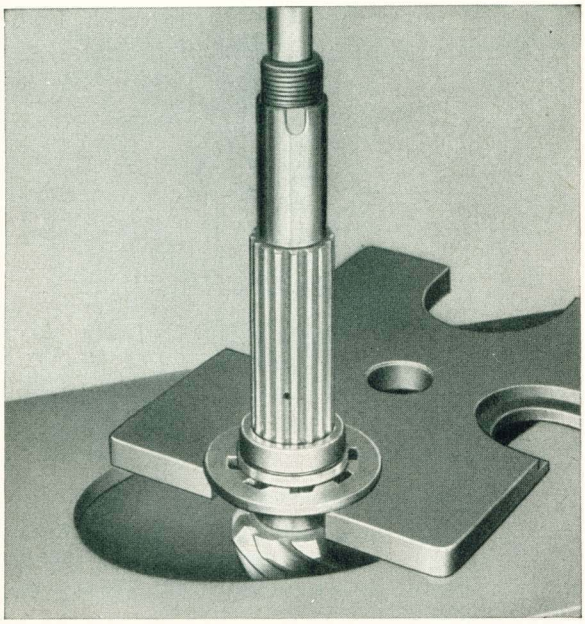
6 - Remove 4th gear, bush, and synchronizer stop ring.





As to the Klingelnberg gear sets, the thrust ring VW 449a is still used on drive pinions with a modulus of 3 or 3.25, and the thrust ring 449b on pinions having 8 teeth (tooth ratio 8 : 35).

Use Repair press VW 400 in conjunction with VW 402, 441 and 449c for the removal of the needle bearing inner ring from the drive pinion shaft.



14 - Clean drive pinion. The oil passages must be free and unobstructed. Compressed air should be used to blow them out.

Inspection

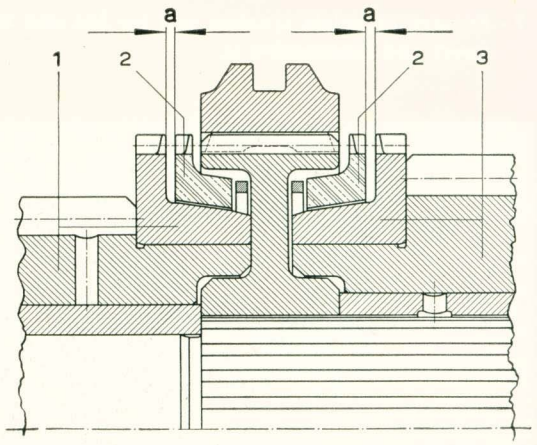
1 - Inspect drive pinion for wear and damage, if necessary replace drive pinion and ring gear as a pair. (Note matching number on pinion and ring gear).

2 - Check condition of roller bearing and double row ball bearing; replace if necessary.

3 - Check gears for wear and damage; replace as necessary (3rd and 4th speed gears only in pairs).

4 - Check all synchronizer components for wear.
a - Clean the internal cone surface of the stop rings with a wire brush.

b - Check the clearance between the stop ring face and the clutch teeth on the corresponding gear. If the wear limit is found to have reached (a = 0.3 mm/0.012″), the stop ring should be replaced. Premature wear of the stop rings is attributable to the clutch being in a bad condition or the driver incorrectly operating the clutch.



a = 0.3 mm (0.012″)
1 - 4th gear
2 - Synchronizer stop ring
3 - 3rd gear

c - If a gear will not engage, although the clutch is fully released, it may be due to the teeth of the stop ring too much out of line with the splines of the operating sleeve. This condition is caused by the slots in the stop ring being worn.

d - All worn parts should be replaced.

5 - Check 3rd and 4th gear bushes, spacer, and shims for wear and replace as necessary.

Assembly

This is a reversal of the above operations, but the following points should be observed:

1 - The roller bearing inner race should be heated in an oil bath to 90 °C (194 °F) before pressing it in position by means of the Repair Press VW 400 in conjunction with VW 401, 411, and 430.

Important!

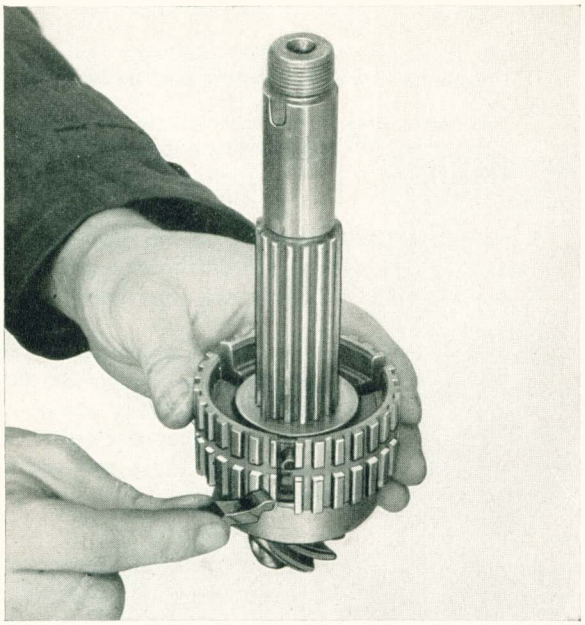
Be sure the roller bearing is a press fit on the drive pinion. A loose fit necessitates a replacement of the worn parts.

2 - Install shim for reducing the total end play of the parts assembled on the splined portion of the drive pinion. Determine the thickness of the shim to be installed after having installed the clutch gear for the 3rd and 4th speeds.

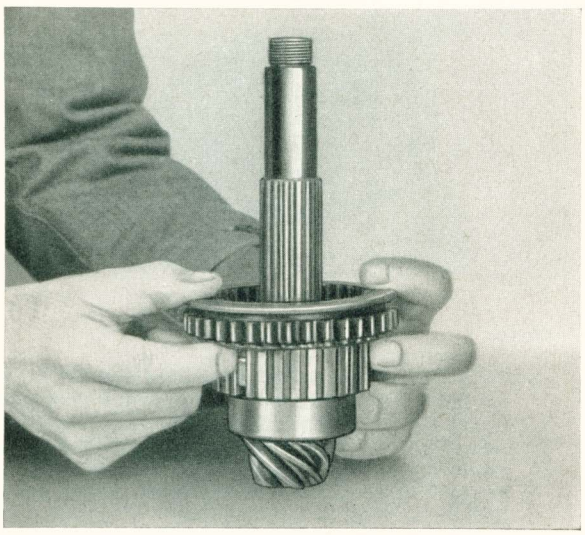
Shims of 0.1 and 0.2 mm (.004″ and .008″) are available for selective fitting.

3 - Install snap ring in the recess cut in the 2nd speed clutch gear.

4 - Slide 2nd speed clutch gear on drive pinion shaft and fit the three coil springs in the provided holes. Put the three shifting plates in position, taking care that their noses are held down by the snap ring.



Press the spring-loaded shifting plates into their slots and slide 1st gear on the clutch gear until the shifting plates engage in the circumferential recess inside the 1st gear.



Be careful that the three chamfered splines of the 1st gear face the shifting plates, as otherwise shifting troubles will arise, necessitating a disassembly of the transmission. Should the shifting plates become dislodged, permitting the 1st gear to slide down after the drive pinion has been assembled, the 1st gear can be repositioned from the pinion side.

Note:

From Chassis No. 1—602400 onwards, the clutch gear for the 2nd speed is provided with an annular groove. The splines of the clutch gear portion that drives the engaged first gear are offset by 0.05 mm—0.08 mm (.002″—0.003″) on the coast side, so that the first gear abuts against the projecting edges of the splines for the 2nd gear when coasting.

Should the first gear on earlier transmissions tend to slip out repeatedly, the installation of the new type clutch gear will be the only remedy.

The splines of the 2nd speed clutch gear which drive the engaged 1st gear are now displaced by 0.02—0.06 mm (.0008″—.0024″) on the coasting sides (previously 0.04—0.08 mm/0.0016″—.0031″). This displacement provides a stop for the 1st gear at the annular groove, thus counteracting the tendency of the 1st gear to slip out when coasting.

Following are the causes that may result in a slipping out of the 1st gear when coasting:

1 - Irregularities at 2nd speed clutch gear

The displacement of the spline coasting sides does not on all splines reach the minimum of 0.02 mm (.0008″).

Remedy:

Install a clutch gear on which the displacement of all splines is at the upper limit (0.06 mm/.0024″).

Caution:

No attempt should be made to remachine the clutch gear in order to obtain a displacement in excess of the upper limit, as such practice will make the 1st gear liable to stick.

2 - Selector fork maladjusted

The 1st gear not sufficiently in mesh.

Remedy:

Position the selector fork further towards the 1st gear. With the 2nd gear engaged, the internal splines of the 1st gear should just cover the clutch teeth of the 2nd gear.

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If the edges of the splines at the annular groove are found to be worn due to the first gear having slipped out, a new clutch gear should be installed on which the displacement is at the upper limit (0.06 mm/.0024″).

3 - Tooth flanks of the 1st speed gears being tapered

The teeth of these gears may have become tapered due to:

a - frequent slipping out,

b - damage caused by constant crashing of gear when shifting down.

In some isolated cases, also defects in material or workmanship may be responsible for such deformation of the teeth.

Remedy:

Replace clutch gear, 1st gear, and main drive shaft.

Important:

After having assembled the drive pinion, check if the 1st gear can be shifted into proper mesh. Correct the position of the selector fork, if found necessary.

To guard against slipping out of 1st gear when coasting the 2nd speed clutch gear (Part No. 113309233 A) has been modified as follows from Chassis No. 1584655:

1 - The splines cf the 2nd speed clutch gear which drive the engaged 1st gear are now displaced on the coasting sides up to the annular groove by 0.03—0.07 mm (.0012″—.0027″) previously 0.02—0.06 mm (.0008″—.0024″).

2 - The annular groove has been displaced by 0.8 mm (.031″) toward the 1st gear. This results in an increased meshing depth with the 1st gear engaged. The dimension from the hardened holding edge to the outer edge of the clutch gear on the side for 1st gear is

New: 21.0—0.3 mm (.827 —.012″)
(previously: 21.8—0.3 mm/(.858″—.012″)

3 - On installation of this clutch gear in transmissions without needle bearings, shorter shifting plates (Part No. 113309239 A) must be installed. The 2nd speed clutch gear (Part No. 113309233) for transmissions without needle bearings will not be available after stocks are used up.

Note:

Main drive shaft and 1st speed gear wheel should only be replaced after repeated slipping out of 1st gear or if, because of improper gear changing, the teeth have become damaged.

The new 2nd speed clutch gear (Part No. 113309233 A) is available as a Spare Part.

5 - Place 2nd speed stop ring on the clutch gear so that the shifting plates engage with the three slots.

6 - Place 2nd and 3rd gears on the bearing bush. Carefully slide the bush on the drive pinion shaft to avoid an upsetting, which would lead to an unpermissible reduction of the radial clearance of the gears.

Note:

Commencing with Chassis No. 1—0575415, the 3rd gear train has an altered number of teeth for better meshing and smoother operation:

Number of Teeth	Earlier Type Part No. 305387	Ratio	New Type Part No. 305387 a	Ratio
3rd Gear on Main Pinion	28	1.22 : 1	27	1.23 : 1
3rd Gear on Drive Drive Shaft	23		22	

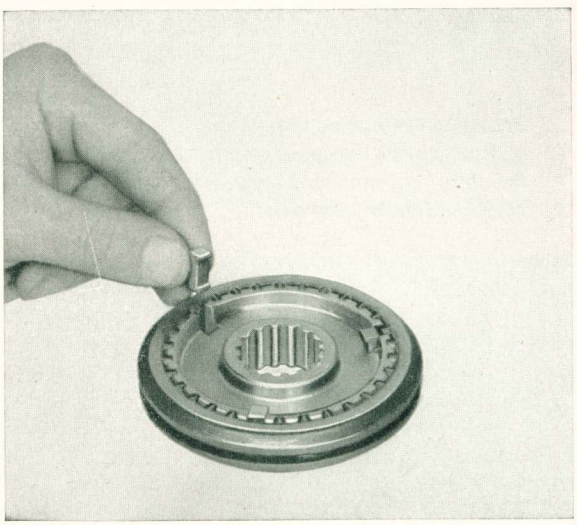
These gears can be installed on earlier cars.

All drive pinions on VW Passenger Cars from Chassis No. 1388439 will be assembled as follows:

The thrust faces of the bush for the 3rd and 4th gears have been enlarged by omitting the 15° inside chamfers.

7 - Place 3rd speed stop ring on the cone surface of the gear. (The synchronizer stop rings for the 3rd and 4th gears are interchangeable).

8 - Assemble synchro unit for 3rd and 4th gears as follows: Slide the operating sleeve on the clutch gear, put the three shifting plates in position, and install the two snap rings. The two ends of the ring must be in one sector between two shifting plates.



Note:

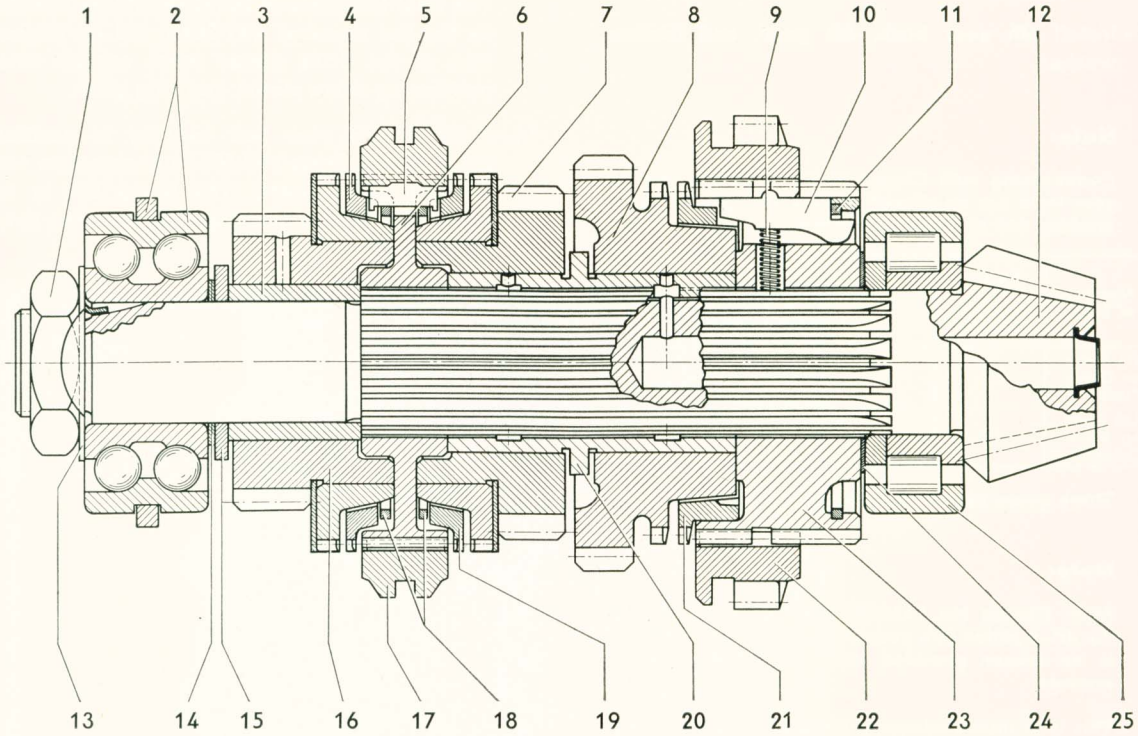
a - From Chassis No. 1—525624 the 3rd and 4th gears on the drive pinion shaft are provided with one thrust ring each. The ring is located at the plain side of the clutch teeth and is to prevent the operating sleeve from moving sidewise when the gear is engaged. It is not possible to provide earlier gears with thrust rings.

b - If the selector fork for the 3rd and 4th gears is worn from contact with the operating sleeve, or if one of the two gears tends to slip out, install the new type parts mentioned below:

Set the selector fork for the 3rd and 4th gears so that the operating sleeve lightly touches the thrust ring of the 4th gear, after having engaged that gear. At the same time care should be taken to insure that the fork is free from lateral thrust in the groove of the operating sleeve.

c - At the same time the width of the operating sleeve for 3rd and 4th gears has been increased to 19.1—19.0 mm (.752″—.748″). On earlier transmissions the width of the operating sleeve amounts to 18.0—17.9 mm (.709″—.705″) or 18.7—18.6 mm (.736″—.732″). Earlier type operating sleeves **must not** be matched with gears being provided with thrust rings.

d - From Chassis No. 1—501 417, the 3rd-and-4th gear selector fork contact faces form a complete radius.



Drive Pinion (Sectional View)

1 - Nut
2 - Double row ball bearing with retaining ring
3 - Bush
4 - Synchronizer stop ring
5 - Shifting plate
6 - Clutch gear
7 - 3rd gear
8 - 2nd gear
9 - Shifting plate spring
10 - Shifting plate
11 - Snap ring
12 - Drive pinion
13 - Lock plate
14 - Shims
15 - Friction washer
16 - 4th gear
17 - Clutch gear sleeve
18 - Snap rings
19 - Synchronizer stop ring
20 - Bush
21 - Synchronizer stop ring
22 - 1st gear
23 - Clutch gear
24 - Shim
25 - Roller bearing

9 - Slide the assembled synchro unit on the drive pinion shaft and turn the third speed stop ring until the shifting plates engage with the slots.

10 - The clutch gear face must be nearly flush with the splines on the drive pinion.

Upper Tolerance Limit

The clutch gear face is 0.05 mm (0.002″) above the splines.

Lower Tolerance Limit

The splines on the drive pinion are flush with the clutch gear face.

If the upper or lower tolerance limit is exceeded, the end play of the parts assembled on the splined portion of the drive pinion should be corrected by fitting a shim between roller bearing and 2nd speed clutch gear or by altering the thickness of the shim. But first it should be made sure that the parts on the splined portion of the drive pinion are correctly assembled.

Note:
From Chassis No. 1388439 all parts on the pinion up to the clutch gear for 3rd and 4th gears are assembled so that the clutch gear face is either flush with or 0.05 mm (.002″) above the spline ends of the pinion.

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Important!

Whenever repairs on earlier cars call for a disassembly of the drive pinion, the new tolerance as specified above should be adhered to. The parts described should be pressed into position.

11 - Place the 4th speed stop rings on the clutch gear so that the shifting plates engage with the slots.

12 - Install 4th gear bush, 4th gear, and friction washer.

Note:

Commencing with Chassis No. 1—0575415, the 4th gear train has an altered number of teeth for better meshing and smoother operation:

Number of Teeth	Earlier Type Part No. 305 417	Ratio	New Type Part No. 305 417 a	Ratio
4th Gear on Drive Pinion	22	0.79 : 1	22	0.82 : 1
4th Gear on Main Drive Shaft	28		27	

These gears can be installed on earlier cars.

Note:

From Chassis No. 1430323 the 4th speed gear on the drive pinion (4th gear train, Part No. 113309341) is no longer provided with the 2.4 mm dia. oil passage.

This is to insure adequate lubrication between gear wheel and bush even at sustained high speed.

Gear wheels of previous design may be used up.

13 - Install shims on drive pinion as required to obtain the correct axial adjustment. Shims of the thicknesses 0.15, 0.2 mm and 0.3 mm (0.008'' and 0.012'') are available for this purpose so that the axial adjustment can be corrected in units of 0.1 of a millimeter.

a - When replacing parts of the drive pinion assembly which do not affect the axial adjustment, the total thickness of the shims should not be altered to insure a correct meshing of pinion and ring gear.

b - When replacing drive pinion or other parts which affect the axial adjustment, the proper amount of shims must be determined once more.

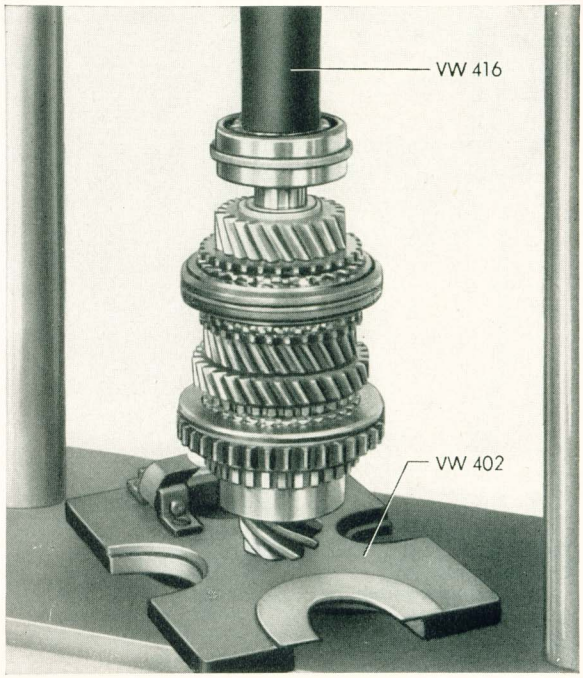
The standard thickness of the total shims is 0.7 mm (0.0275''). The plus or minus marking on the drive pinion face must be considered in this connection.

Example:

Standard thickness of shims	0.7 mm
Axial tolerance discrepancy — 0.18 mm. This value is to be raised to the next tenth of a millimeter, namely	— 0.2 mm
Total thickness of shims required	0.5 mm

The total thickness of shims should be checked by the test mandrel VW 289b and an impression of the drive pinion tooth contact when positioning drive pinion and ring gear.

14 - Press double row ball bearing in position, using Repair Press VW 400 in conjunction with VW 402 and VW 416. The filling slot in the outer race of the bearing must face the drive pinion nut.



15 - Install new lock plate after it has been coated with graphited oil.

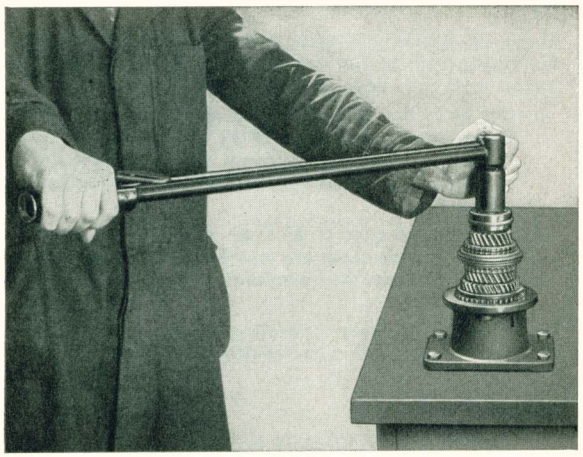
Note:

The thrust face of the drive pinion nut should be dipped into graphited oil to prevent the nut from seizing on the lock plate, as this would lead to the tab breaking off.

Important!

It is absolutely necessary to use a new lock plate whenever the drive pinion nut has been removed.

16 - Tighten drive pinion nut with a torque wrench to a torque of 11—12 mkg (80—87 ft. lbs.).

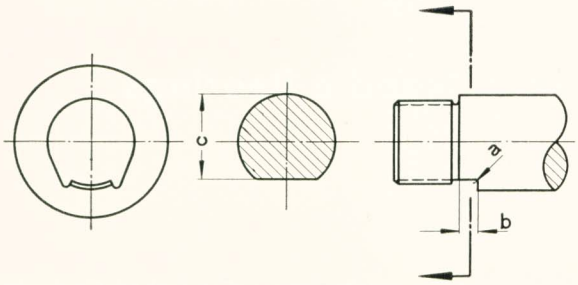


Important!

Be sure not to exceed a torque of 12 mkg (87 ft. lbs.), as this would even cause the tab of a graphite-coated lock plate to break off.

Note:

In place of the groove for the tap of the lockplate from Chassis No. 1454551 the drive pinion is now provided with a flat surface. The shape and dimensions of the new lockplate have been altered accordingly.

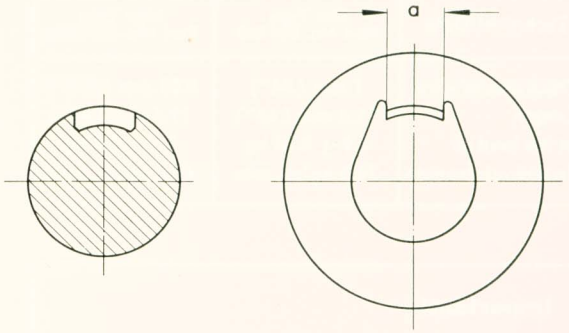


a = 0.5 r + 0.5
b = 5 + 0.2 mm
c = 22.3 − 0.2 mm

The new lockplate can be used on previous drive pinions if the sides of the groove are filed off as specified on the drawing.

In older transmissions the nut must only be tightened to the new torque if the drive pinion has been provided with a flat surface and if the new lockplate has been installed. Otherwise tighten to a torque of 80—87 ft. lbs.

From Chassis No. 1595675 the groove for the lockplate tab on the main drive shaft (Part No. 113309101) is now 3 mm (.117″) wider and provided at the base with a convex surface. Shape and dimensions of the new lockplate (Part No. 113309151 A) have been altered appropriately. The torque for the nut remains unchanged at: 4.0—5.0 mkg/29—36 ft. lbs.



a = 7.5 + 0.3 (.292″ + .012″)
(previously: 4.5 + 0.3 (.176″ + .012″)

Important!

The new lockplate cannot be installed on the drive shaft of previous design and vice versa.

17 - Check end play of 2nd, 3rd, and 4th gears. The following limits should not be exceeded.

	Lower Limit	Upper Limit
2nd gear	0.10 mm (0.004″)	0.25 mm (0.0098″)
3rd gear	0.10 mm (0.004″)	0.25 mm (0.0098″)
4th gear	0.10 mm (0.004″)	0.25 mm (0.0098″)

18 - Secure the nut not before the axial adjustment of the drive pinion has been checked.

Note:

The following modifications have been carried out to eliminate difficulties in engaging second gear.

A - From Chassis No. 1—632758

a - The internal splines of the first gear are beveled at the second gear side (7 degrees).

b - The clutch teeth of the second gear are also beveled.

B - From Chassis No. 1—599151

The synchronizer stop ring has been reshaped and is also beveled at the first gear side.

C - From Chassis No. 1—583813

The shifting travel of the second gear has been altered. The distance between the intermediate detent ball undercut and the undercut for the 2nd gear on the 1st-and-2nd selector shaft amounts now to 10 mm (.4″), formerly 8.5 mm (.23″), as measured from center to center of undercuts. The total length of the selector shaft is 207 mm (8.15″), formerly 208.5 ± 0.5 mm (8.208 ± .02″).

D - From Chassis No.—1—583187

From the above number, weaker shifting plate springs are used. When carrying out repairs, care should be taken that springs of the same type are used.

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Technical Data	Old Type Part No. 305 365	New Type Part No. 305 365a
Thickness of wire	1 mm (.04″)	0.85 mm (.033″)
Length	11.6 mm (.46″)	11.6 mm (.46″)
at the load of	4.9 ± 0.34 kg	2.5 ± 0.2 kg
Torsional strength	74.5 kg/sq. mm	60.0 kg/sq. mm

Important!

Earlier type transmission parts can be replaced as follows:

a - 1st gear and selector shaft can only be replaced as a pair. The two parts must always be either of the earlier or of the later type.

b - The 2nd gear and the synchronizer stop ring for the 2nd gear can be replaced separately.

It is recommended to replace all parts mentioned under the points from A to D only when trying to **eliminate difficulties in engaging the 2nd gear** of earlier transmission.

Note:

To guard against a slipping out of the 3rd or 4th gear, the clutch teeth of the 3rd and 4th gears on the drive pinion shaft have been modified as follows:

a - On 24 of the 30 clutch teeth up to 0.21 mm (.008″) more metal is machined off the coasting side. The six remaining teeth (two groups of three each being diametrically opposite) have not been modified in this way.

b - The driving sides of all teeth and also the coasting sides of the six teeth are machined to incline by max. 2 degrees from the chamfered end toward the thrust ring.

c - The 3rd/4th gear operating sleeve will thus only bear on six teeth when coasting in 3rd or 4th.

Service Instructions

1 - A subsequent installation of the 3rd gear train or 4th gear train with altered clutch teeth is only justified after corrections of the gear lever stop plate and selector fork adjustments have failed to effect a cure.

2 - Other parts should only be replaced if damaged or worn beyond the wear limit.

3 - All parts on the drive pinion shaft up to the 3rd/4th clutch gear are to be assembled on the shaft with pressure (122 + 0.05 mm/4.8″ + .002″). However, the end play given in the Shop Manual for the individual speed gears on the drive pinion should be adhered to.

4 - Carefully adjust the selector fork.

5 - The 2nd gear clutch teeth were modified in the same manner at an earlier date.

Synchromesh Transmission — Needle Bearings

Date introduced: Nov. 11th, 1957
From Chassis No.: 1 726 006
From Rear Axle No.: 1 429 355

As of the above-mentioned date, the synchromesh transmission of the VW Passenger Car will be fitted with two needle bearings to replace the rear ball bearing on the main shaft and the roller bearing on the pinion assembly. Furthermore, gearwheel pairs with a modified tooth ratio will be installed for the 3rd and 4th speed.

1 - In place of the roller bearing (Spare Part No. 111 307 219), a needle bearing (Spare Part No. 113 309 219) will be fitted on the pinion assembly. Service installation of this needle bearing in transmissions of older design is not possible.

2 - A dowel pin (Spare Part No. 113 309 223) secures the needle bearing in the crankcase bore.

3 - A needle bearing (Spare Part No. 113 309 125) will be fitted in place of the rear ball bearing (Spare Part No. 111 307 125) on the main shaft. Service installation of this needle bearing in transmissions of older design is not possible.

4 - The requisite lock pin (Spare Part No. 113 309 521 A) serves to retain the needle bearing in the crankcase bore and to secure the reverse sliding gear shaft (Spare Part No. 113 309 515 B). Offset relative to the center of the bearing bore, this cylindrical pin is no longer accommodated in a bore as heretofore but rests now in a groove in the reverse sliding gear shaft. For this reason the transmission case has been provided with a through-bore for the lock pin. Service installation of the lock pin and of the modified reverse sliding gear shaft in a transmission of older design is not possible. As a general rule, parts of older design cannot be fitted in the new type transmission case.

5 - The main shaft (Spare Part No. 113309101 A) is no longer provided with a shoulder to limit the seat of the ball bearing fitted up to now. Service installation of this main shaft in a transmission of older design, or of an old main shaft in a transmission of new design, is not possible.

6 - Due to the smaller outside diameter of the two needle bearings, the bearing bores in the transmission case (Spare Part No. 113301031 B) have been reduced in size. In the transmission case web which is wider now, a bore has been provided between the needle bearings to accommodate a hex. head mounting bolt M 7 x 170 (Spare Part No. N 103221). Transmission cases of older design cannot be exchanged for cases of the new design.

7 - The bevel gear of the pinion assembly has been shortened by 2 mm on the shaft side because the needle bearing is 2 mm wider than the roller bearing fitted previously. The new pinion assembly has the Spare Part No. 113517141 B. It may be installed in older transmissions with roller bearing or special needle bearing only in conjunction with a 2 mm spacer (Spare Part No. 113309231). The inside chamfer of the spacer has to face toward the bevel gear. Pinion assemblies of older design will be fitted only as long as present stocks last.

8 - The clutch gear for the 2nd gear (Spare Part No. 113309233 A) has a small recess on the side facing the needle bearing thus providing sufficient play for the bearing. The modified clutch gear can be fitted in transmissions of older design. However, clutch gears of older design cannot be fitted in transmissions that have needle bearings.

9 - In connection with the modification of the clutch gear for 1st and 2nd gear, the overall length of the shifting plates (Spare Part No. 113309239 A) for 1st and 2nd gear has been reduced from 27 mm (1.06″) to 26.5 mm (1.04″) to ensure sufficient play for the needle bearing. Shifting plates of the former design may be replaced by plates of new design but plates of the new design cannot be replaced by old ones.

10 - In place of the 0.1 mm (.0039″) and 0.15 mm (.0059″) thick shims (Spare Part Nos. 113309225/227) between needle bearing (Spare Part No. 113309219) and clutch gear for 2nd gear (Spare Part No. 113309233 A), shims of a smaller outside diameter (Spare Part Nos. 113309225 A/227 A) are now fitted. The large shims continue to be used for transmissions of older design.

11 - Modified gearwheel pairs (Spare Part Nos. 113309275 A/341 A) are now being fitted for the 3rd and 4th speed in place of the pairs (Spare Part Nos. 113309275/341) which had tooth ratios of 22 : 27 and 27 : 22. The new wheels have tooth ratios of 23 : 28 and 28 : 23. They may also be used in transmissions of older design. When installing special needle bearings, the new gearwheels have to be fitted, too (please see Workshop Bulletin H/125).

12 - To mark the transmissions with needle bearings, an "N" is punched into the transmission case next to the transmission number.

Attention

Magnetic oil drain plugs (Spare Part No. 111101197) should be service-fitted whenever transmissions not yet equipped with such plugs are brought in for repairs. These magnetic oil drain plugs are also available in oversize (Spare Part No. 111101199). Their efficiency depends to a considerable degree on proper and regular cleaning.

Synchromesh Transmission — Service Installation of Special Needle Bearings

Whenever necessary, it is possible in the synchromesh transmissions to replace the radial ball bearing on the main shaft and the cylindrical roller bearing for the drive pinion (rear) by special needle bearings. The radial ball bearing on the main shaft (front) may be replaced by a tapered roller bearing. Furthermore, 3rd and 4th speed gear wheel pairs with a modified gear ratio have to be fitted in order to ensure continued quietness of operation in these speeds after needle bearings have been installed.

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The following points should be observed for service installation:

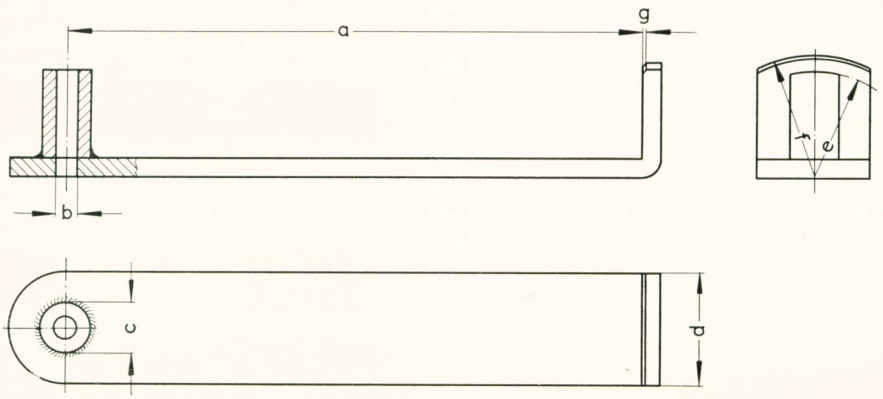
1 - The radial ball bearing on the main shaft (rear), Spare Part No. 111307125, should be replaced by a special needle bearing, Spare Part No. 113309125 A. This needle bearing has the same outside diameter as the radial ball bearing. The main shaft does not have to be replaced if the seating surface for the needle bearing is in proper condition.

2 - A longer locking pin (Spare Part No. 113309521 B) has to be used to secure the needle bearing and the reverse sliding gear shaft. The faced reverse sliding gear shaft (Spare Part No. 113309515 A) may continue to be used.

3 - The radial ball bearing on the main shaft (front), Spare Part No. 113309123 may be replaced by a tapered roller bearing, Spare Part No. 211309123, with split inner race.

4 - The cylindrical roller bearing for the drive pinion (rear), Spare Part No. 111307219, is to be replaced by a needle bearing, Spare Part No. 113309219 A. Due to the greater thickness of the outer race, this needle bearing has the same outside diameter as the cylindrical roller bearing.

5 - This needle bearing is to be secured in the transmission case bore by means of a cylindrical pin (Spare Part No. 113309223). For this purpose, a hole of 6.0 mm ⌀ should be drilled in the seat for the needle bearing at a distance of 153.2 $\pm$ 0.1 mm from the contact surface for the locking ring of the double-race ball bearing (Spare Part No. 111307375). Measured from the case partition, this hole should be 39.0 $+$ 0.3 mm deep. If necessary, the bore for the cylindrical pin should then be reamed to a diameter of 6.00/6.12 mm. The requisite gauge shown below can be made at the workshop.



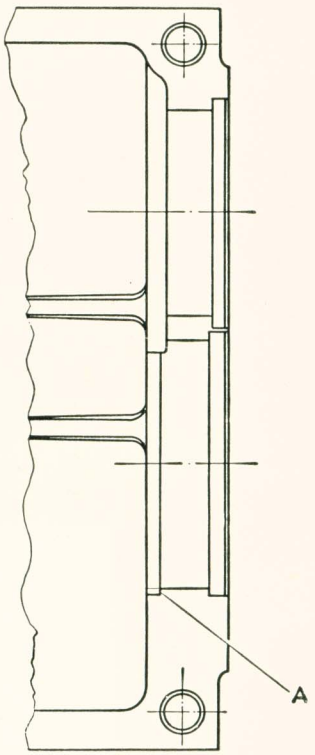
a = 153.2 $\pm$ 0,1 mm
b = 6.0 mm ⌀
c = 13.0 mm ⌀
d = 30.0 mm
e = r 31.0 mm
f = r 33.0 mm
g = 1 mm 45°

6 - The drive gear set does not have to be replaced. However, if the old set is damaged, a new one (Spare Part No. 113517141 B) is used with a 2 mm thick spacer (Spare Part No. 113309231) fitted between the bevel gear of the pinion and the needle bearing and the inside chamfer facing toward the bevel gear. The reason for this arrangement is that the bevel gear engaging this pinion is 2 mm shorter on the shaft side. In all other respects the instructions given under points 4,7 and 8 apply also to the installation of this gear set. After available stocks have been exhausted, the gear sets used up to now will no longer be fitted as the new set (Spare Part No. 113517141 B) can be subsequently installed with the spacer (Spare Part No. 113309231) in all transmissions of olger design.

7 - The shims (Spare Part No. 113309225/227) between cylindrical roller bearing and 2nd speed clutch gear (synchronizing unit) should be replaced by shims of smaller outside diameter. These shims are 0.1 mm and 0.15 mm thick and have the Spare Parts No. 113309225 A. They are to be inserted, according to requirement, between needle bearing and clutch gear in such a manner that all parts on the pinion up to 3rd/4th speed clutch gear (Spare Part No. 113309309) protrude up to 0.05 mm beyond the splined ends of the pinion i. e. that they are press-fitted.

8 - The 2nd speed clutch gear (synchronizing unit), Spare Part No. 113309233, and the 1st/2nd speed shifting plates (Spare Part No. 113309239) do not need to be replaced.

9 - The 3rd and 4th speed gear wheel pairs (Spare Part Nos. 113309275/341) with gear ratios of 22 : 27 and 27 : 22 have to be replaced by modified pairs (Spare Part Nos. 113309275A and 113309341A) with ratios of 23 : 28 and 28 : 23. After installation, check with the transmission case open whether or not the 4th speed gear on the pinion at the bottom of the case partitions runs freely and without interference on the shift gear housing side. If it does not, it will be necessary to rework the housing at the spot indicated (A).



Attention

Take advantage of all transmission repairs to fit magnetic oil drain plugs (Spare Part No. 111101197) which are also available in oversize (Spare Part No. 111101199). Their efficiency depends to a considerable degree on prompt and regular cleaning.

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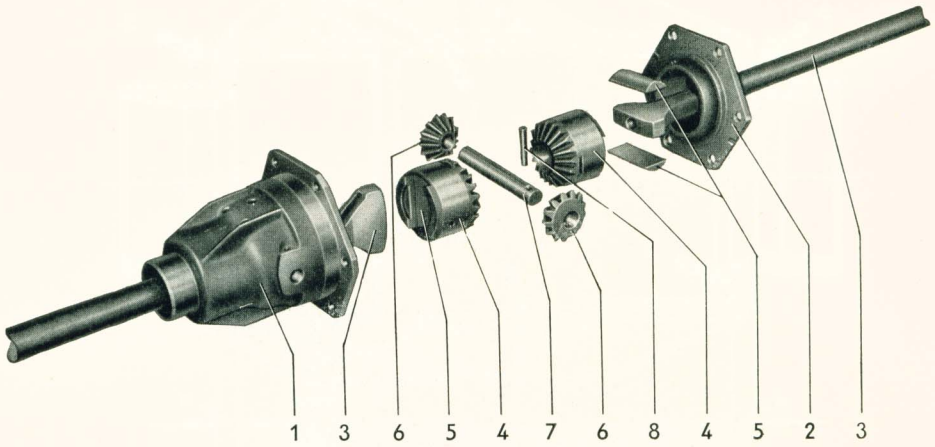
Reconditioning Differential



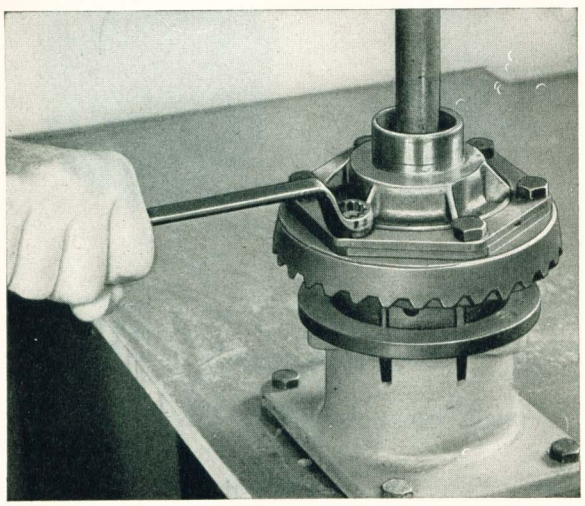
1 - Housing
2 - Cover
3 - Rear Axle Shaft
4 - Differential Side Gear
5 - Fulcrum Plates
6 - Differential Pinion
7 - Differential Pinion Shaft
8 - Lock Pin

Disassembly

1 - Open transmission case and remove differential and rear axle shafts.

2 - Place differential in holding fixture VW 314.

3 - Remove lock wire and ring gear retaining screws.



4 - Take off differential housing cover, rear axle shaft, differential side gear and fulcrum plates.

5 - Lift off ring gear.

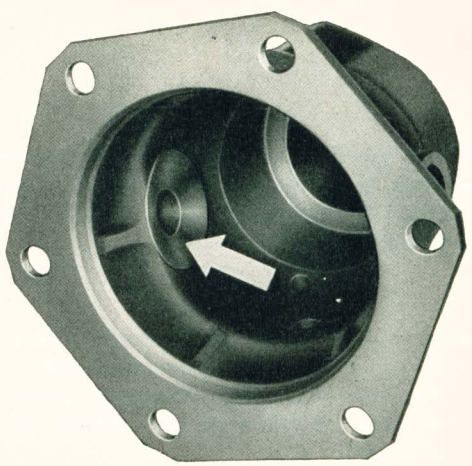
6 - Remove lock pin of differential pinion shaft.

7 - Take off differential pinion shaft and differential pinions.

8 - Lift off rear axle shaft, differential side gear and fulcrum plates from differential housing.

Inspection

1 - Check concave differential pinion contact surface in differential housing for wear. If wear is apparent, replace differential housing. The distance between the contact surfaces must be between 80.046 mm and 80.000 mm (3.1514'' and 3.1496'').



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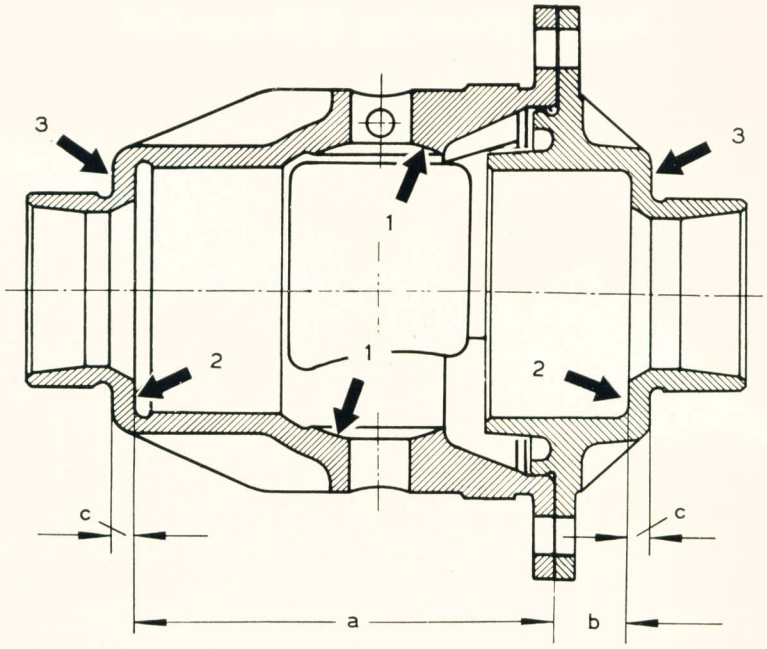
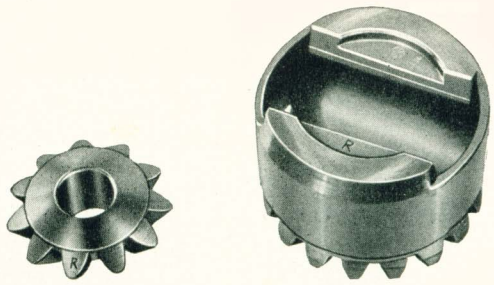


1 - Contact surface for differential pinion
2 - Contact surface for differential side gear
3 - Contact surface for differential shim

a - Depth of differential housing 109 mm (4.29″)
b - Depth of differential housing cover 19 mm (0.75″)
c - Minimum thickness of wall 4.0 mm (0.16″)

2 - Inspect differential housing and cover for wear on contact surfaces for differential side gears and differential shims. Replace if necessary.

It is permissible to remachine the contact surfaces but care must be taken not to remove more metal than prescribed by dimension c on the drawing.



3 - Check rear axle shafts and differential components for evidence of damage and wear. Replace, if necessary, after having observed the following points:

a - A replacement of the differential side gears and pinions requires attention to the matching instructions. The differential gears are marked according to the various cutting methods.

Group 1: Gleason G
Klingelnberg K
Klingelnberg (altered) V
} These marks are not always present

Group 2: Revacycle method R

Attention!

When replacing differential gears, only those of the same cutting method must be matched.

b - The number of teeth of differential gears are at a modulus of 3.9:

Differential side gear ..... 17 teeth
Differential pinion ..... 11 teeth

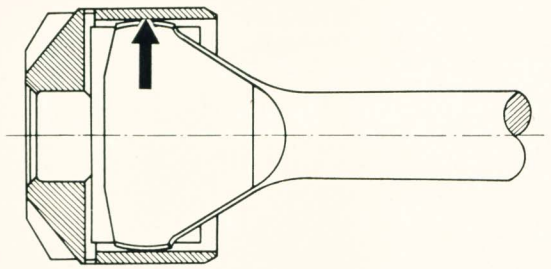
Only gears of the same modulus must be fitted to one differential.

Note:

The differential pinion shaft (Part No. 111517177) has been provided with two flat sides at the contact faces for each of the differential pinions from Chassis No. 1483446 and in series production from Chasiss Nol. 1600440. This alteration has been carried out to improve lubrication.

Stocks of differential pinion shafts not provided with the flat sides may be used up.

c - The fitting clearance between the flat end of the rear axle shaft (measured across the ball-shaped sides) and the inner diameter of the differential side gear is between 0.03 and 0.1 mm (0.0012'' and 0.004'').



Rear axle shafts and differential side gears fall into three groups and are mated in accordance with the prescribed tolerances.

Paint Mark	Side Gear Inner Diameter	Axle Shaft Outer Diameter
Blue	59.97—60.00 mm (2.3610''—2.3622'')	59.90—59.94 mm (2.3582''—2.3598'')
Pink	60.01—60.04 mm (2.3625''—2.3637'')	59.95—59.97 mm (2.3602''—2.3610'')
Green	60.05—60.07 mm (2.3641''—2.3649'')	59.98—60.00 mm (2.3614''—2.3622'')

The paint mark of the side gear is found on the recessed face in the form of a dot. The axle shaft is marked by a ring painted 150 mm (6'') from the flat end.

Excessive clearance may lead to a noisy operation of the rear axle shaft.

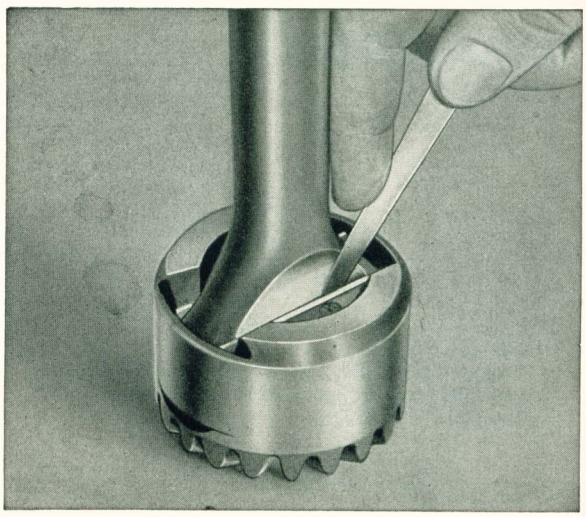
4 - Check rear axle shaft for run-out at ball bearing seat, the allowable run-out being 0.05 mm (0.002''). If the run-out is slightly in excess of this value, straighten rear axle shaft in Repair Press VW 400 in conjunction with VW 405 and VW 406 in cold condition.

5 - Inspect ring gear for wear and damage. If necessary, replace ring gear and drive pinion as a pair. (Note matching number.)

Assembly

1 - The differential housing should be thoroughly oiled before assembly.

2 - Check fitting clearance of rear axle shaft/ fulcrum plates/differential side gear. In the case of excessive clearance, fit oversize fulcrum plates marked by a groove on their faces, or replace worn parts.



Note:

From Chassis No. 1170815 the fulcrum plates inside the differential of all current production cars are copper plated. These fulcrum plates are of standard size and replace those of previous design which are no longer available as spares.

Copper-plated fulcrum plates can be incorporated in earlier cars as a remedy for grinding noises audible when reversing at low speed. As is already known, these noises have no bearing on the life and dependability of the rear axle, so that normally no actions are necessary.

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3 - The lock pin for the differential pinion shaft should be peened in position.

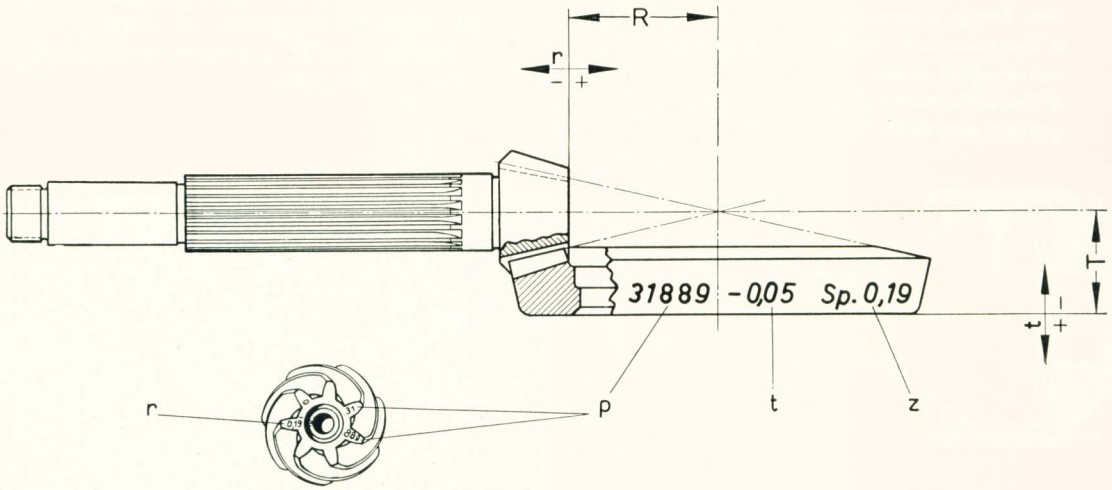
4 - Keep the contact surfaces of the differential housing and ring gear absolutely clean to insure an even backlash.

5 - Tighten ring gear retaining screws to a torque of 6 mkg (45 ft. lbs.) and secure them with a piece of wire.

Important!

The wire should be threaded through the holes in a way which insures a right-hand tension on all screws when intertwining its end.

Adjustment of Drive Pinion and Ring Gear (Crown Wheel)



p = Matching number
T = Distance from drive pinion center line to ring gear back face (constant value 40.00 mm/1.575″)
f = Departure from T

R = Distance from ring gear center line to drive pinion face (see table below)
r = Departure from R
z = Backlash (mm)

	Klingelnberg 7 : 31		Gleason	
	m = 3,00	m = 3,25	7 : 31	8 : 35
Designation	K	V	—	—
R	59.22	59.22	59.35	55.75

Silent operation and minimum wear of the final drive depend on the proper adjustment of drive pinion and ring gear. Drive pinions and ring gears are machined in pairs to very close limits. A rigid inspection by means of special testing appliances assures proper tooth contact and silent meshing in both turning directions. Both the drive pinion and the ring gear can be moved to secure proper adjustment. Departures from the normal position and the correct backlash (Sp) are measured and written on the drive pinion or ring gear respectively. Each pair of drive pinions and ring gears are provided with a matching number. It is not permissible to replace a drive pinion or ring gear separately.

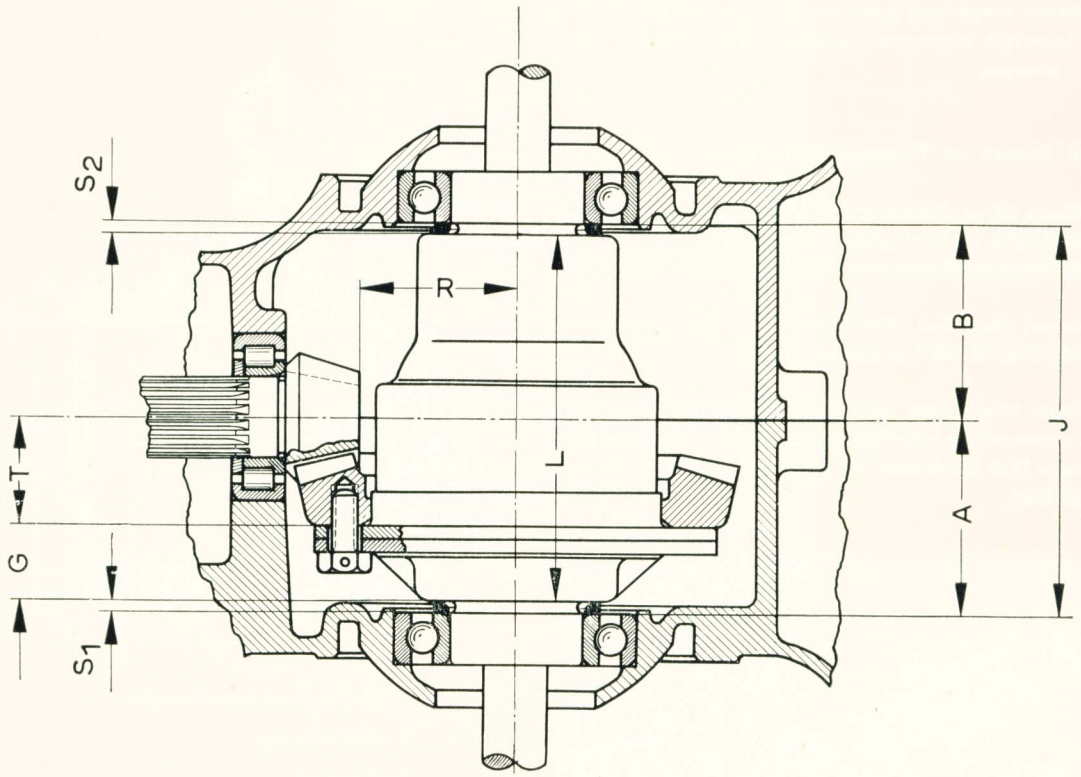
The object of the rear axle adjustment is to obtain the same favourable gear meshing as determined in the factory by precision testing machines. This is facilitated by the values written on the gears.

The correct position is determined by the distance from the drive pinion center line to the ring gear and the distance from the ring gear center line to the drive pinion. A proper adjustment requires attention to the following pages.

Fundamental Hints of Ring Gear (Crown Wheel) Adjustment

The crown wheel is attached to the differential housing by screws. Adjustment is effected by two shims, one on each side of the differential housing. The proper thicknesses of the shims are determined after having measured the required dimensions.

To determine the thicknesses of the shims, "S 1" and "S 2" on the drawing, the following dimensions are required:



Designation	Measurements	Standard
A*	Depth of left transmission case half	72.55 mm (2.8563″)
B	Depth of right transmission case half	72.55 mm (2.8563″)
J	Total depth of transmission case	145.10 mm (5.7126″)
L	Length of differential housing	138.00 mm (5.4331″)
G	Distance from ring gear back face to shim contact face	28.95 mm (1.1398″)

* Not required, if using test mandrel VW 289b.

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The readings should be taken precisely to 0.01 of a millimeter (0.0004 of an inch.). The dimension T (distance from drive pinion center line to crown wheel back face) is constant and amounts to 40.00 mm (1.575″).

When determining the shims, the plus or minus marking t on the crown wheel must be taken into account.

The preload V on the two differential ball bearings should be within 0.10 and 0.18 mm (0.004″ and 000.7″). Thus, with a mean value of 0.14 mm (0.0055″), it is necessary to add $\frac{V}{2} = 0.07$ mm (0.0027″) to each shim.

Adjusting Ring Gear with VW Measuring Devices

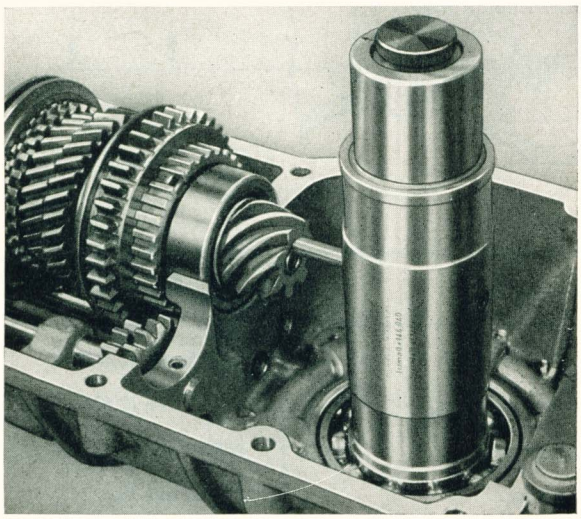
To be sure of accurate readings, the surfaces with which the measuring devices make contact must be absolutely clean and not damaged. The differential ball bearings must seat squarely on the bottom of their recesses.

Total Depth of Transmission Case J

1 - Place drive pinion in left transmission case half and take up end play by tapping it toward the differential chamber with a light-metal hammer.

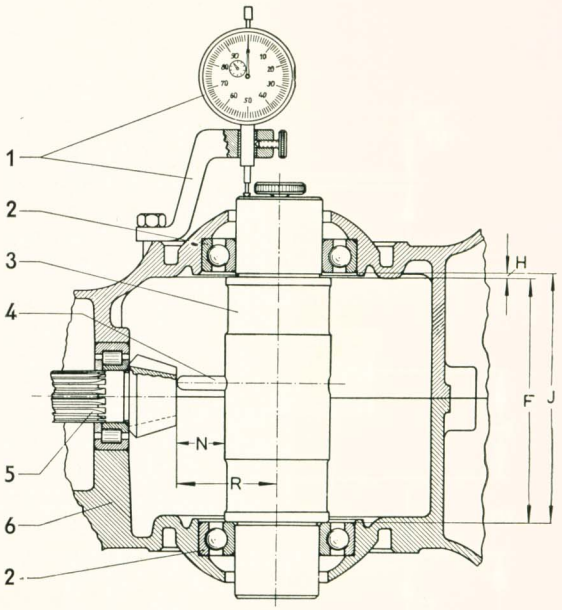
2 - Insert mandrel VW 289b in differential ball bearing of left transmission case half.

3 - Push tracer pin into mandrel and lock it by means of the knurled-head screw so as to make sure that the tracer pin does not touch the drive pinion.



4 - Place right transmission case half on left half and tighten by means of four screws.

5 - Attach dial indicator as shown below and adjust it to zero on the mandrel.



1 - Dial indicator and bracket

2 - Ball bearings

3 - Mandrel

4 - Tracer pin

5 - Drive pinion

6 - Transmission case

F - Length of mandrel

H - Measured value (deflection of needle when turning transmission case by 180°)

J - Total depth of transmission case

N - Length of tracer pin

R - Distance from ring gear center line to drive pinion face

6 - Turn transmission case 180°. The axial movement of the mandrel against the ball bearing in the right transmission case half is indicated by the deflection of the needle. The total depth J is obtained by adding the indicated value to the length of the mandrel.

Example:

F = 143.50 mm
+ H = 1.70 mm
J = 145.20 mm

7 - After the depth of the transmission case has been measured, distance R for the axial adjustment of the drive pinion should be checked before removing the mandrel.

Depth of right transmission case half B

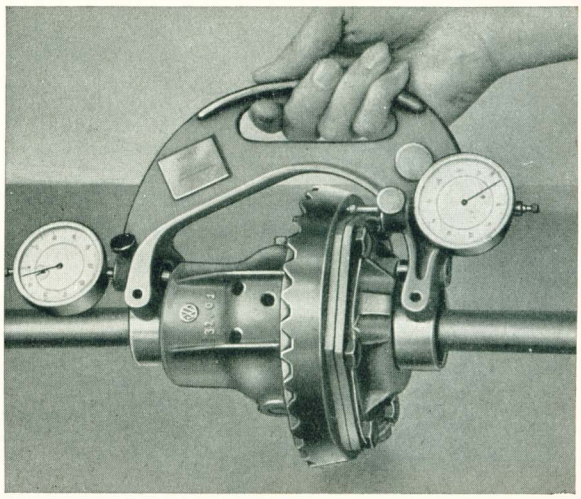
This dimension is to be ascertained by a ruler and a depth micrometer or a depth gauge.

It is recommended to repeat the measuring at three points of the ball bearing inner race and ascertain the mean value.

Length of the differential housing L and distance from ring gear back face to shim contact face G

1 - Adjust dial indicators of gauge VW 287 to zero, using the master gauge.

2 - Place gauge on differential housing. The readings obtained are to be added to or subtracted from the standard dimensions according to the deflections of the needles.



Example:

Standard dimension for	L =	138.00 mm
Reading	= —	0.15 mm
Actual dimension of	L —	137.85 mm
Standard dimension for	G =	28.95 mm
Reading	= —	0.05 mm
Actual dimension of	G =	28.90 mm

Emergency Method of Adjusting Ring Gear

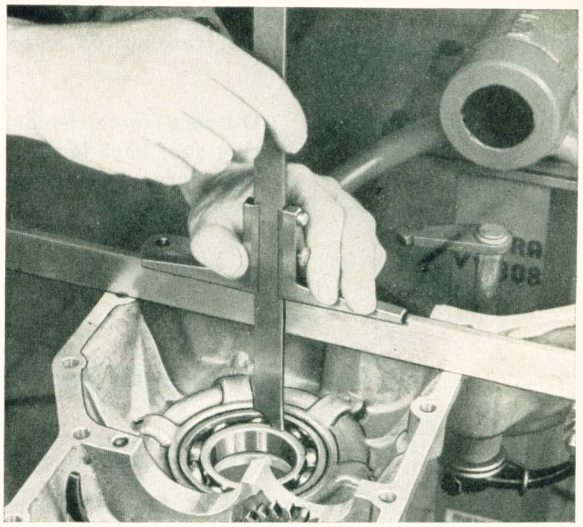
If the gauges VW 287 and VW 289 b are not available the measuring can be done with ruler, depth gauge, and caliper square.

Total Depth of Transmission Case J

1 - Measure left and right transmission case halves A and B with ruler and depth gauge.

2 - The depth gauge is to make contact with the inner race of the ball bearing. Repeat the measuring at different points.

3 - Add the measured values of A and B to obtain the total depth J of the transmission case.



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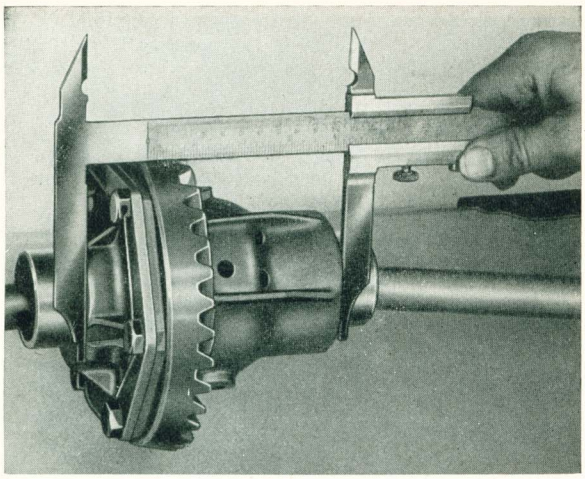
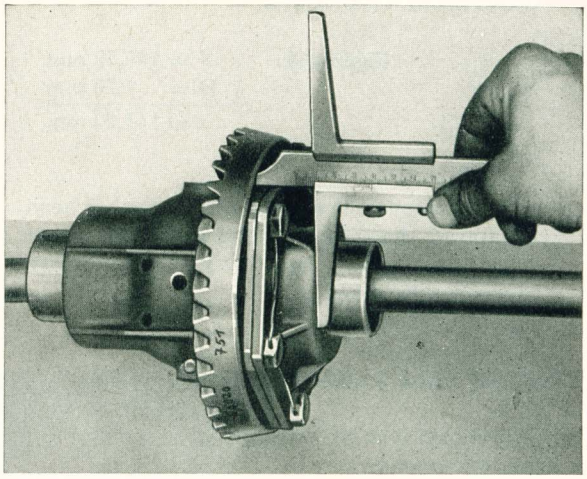
Length of Differential Housing L

The length of the differential housing is measured with a caliper square.

Distance from Ring Gear Back Face to Shim Contact Face G

This distance is measured with a depth gauge.





How to Determine Thicknesses of Shims

The thicknesses of the two differential shims (S 1 and S 2) are determined as illustrated by the following example.

$$\text{Formula: } S1 = J - B - (T \pm t) - G + \frac{V}{2}$$

$$S2 = J - L + V - S1$$

Example:

1 - Differential shim S 1

J	Total depth of transmission case		145.20 mm
— B	Depth of right transmission case half		— 72.65 mm
			72.55 mm
— (T ± t)	T Distance from drive pinion center line to ring gear back face	40.00 mm	
	— t departure from T (plus or minus marking on ring gear)	— 0.05 mm	
		39.95 mm	
			— 39.95 mm
			32.60 mm
— G	Distance from ring gear back face to shim contact face		— 28.90 mm
			3.70 mm
$+\frac{V}{2}$	Half the preload on ball bearing		+ 0.07 mm
S 1	Thickness of left differential shim		= 3.77 mm

2 - Differential shim S 2

J Total depth of transmission case	145.20 mm
— L Length of differential housing	— 137.85 mm
	7.35 mm
+ V Preload	+ 0.14 mm
	7.49 mm
— S 1 Thickness of left shim	— 3.77 mm
S 2 Thickness of right shim	= 3.72 mm

A selection of shims is available in the thicknesses from 2.9 to 4.5 mm (2.9, 3.0, 3.1, 3.2, 3.3, etc.). Additionally, shims of the thickness 0.25 mm are available to provide for adjustments in units of 0.05 mm.

The shim thicknesses determined are to be increased or reduced to the next dimension which conforms with the shims available, but the total shim thickness of S 1 and S 2 must remain within the permissible tolerance to ensure that the two differential ball bearings are properly preloaded; e. g.

Determined shim thicknesses: S 1 = 3.77 mm; S 2 = 3.72 mm; S 1 + S 2 = 7.49 mm
Approximate shim thicknesses: S 1 = 3.80 mm; S 2 = 3.70 mm; S 1 + S 2 = 7.50 mm

Check thickness of shims with micrometer, measuring at four different points. Permissible departure 0.03 mm. Before measuring, make sure there is no burr at the shim.

Adjusting Drive Pinion

General

The basic adjustment has already been carried out in assembling the drive pinion by the fitting of shims as detailed under the heading "Reconditioning Drive Pinion".

Adjustment

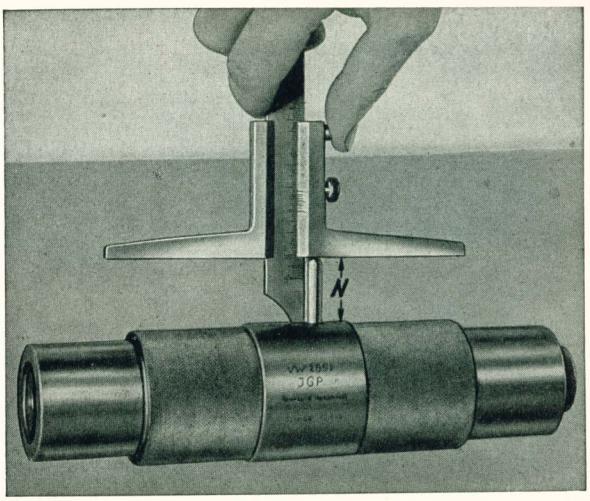
1 - The distance for the axial adjustment of the drive pinion should be measured by the mandrel VW 289 b immediately after the total depth of the transmission case (J) for the ring gear adjustment has been measured.

2 - Turn the mandrel until the arrow points to the gearshift housing. Loosen knurled-head screw so that the tracer pin makes contact with the drive pinion face.

3 - Tighten knurled-head screw and turn mandrel 90° to avoid the position of the tracer pin becoming altered when opening transmission case.

4 - Remove mandrel and measure length of tracer pin N with a depth gauge.

5 - Add half the diameter (radius) of the mandrel to the measured length of the tracer pin. The value obtained must correspond to the distance R after the tolerance discrepancy r (plus or minus marking on drive pinion face) has been added or subtracted. Care should be taken, however, to make sure that a minus amount is added to and a plus amount subtracted from distance R (see example below).



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Example:

a - Standard dimension of R	59.22 mm
Tolerance discrepancy r = — 0.18 mm Insert	+ 0.18 mm
Fitting dimension	59.40 mm
Rounded off	59.4 mm
b - Radius of mandrel	30.00 mm
Length of tracer pin	29.6 mm
Dimension measured	59.6 mm

In comparing the value measured (59.6 mm) with the fitting dimension (59.4 mm), it will be found that the total thickness of the drive pinion shims must be increased by 0.2 mm.

Note:

The measuring of the drive pinion axial adjustment with mandrel VW 289b does not render unnecessary a check of the tooth contact.

Klingelnberg Toothing

From Chassis No. 1258990, apart from the usual set (modulus: m = 3.00), the standard and synchromesh transmissions will also be equipped with Klingelnberg drive pinions and ring gears having a tooth ratio of 7 : 31 and a modulus of 3.25. This modification is to increase the strength of drive pinion and ring gear.

Gleason Toothing

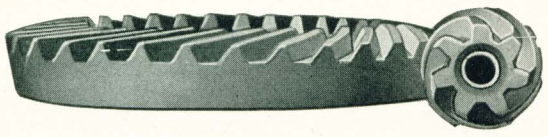
From Chassis No. 1193483 Gleason gear sets — ratio of teeth 7 : 31 — are being installed. The follwing points should be noted when installing this gear set — ratio of teeth 7 : 31 (formerly 8 : 35):

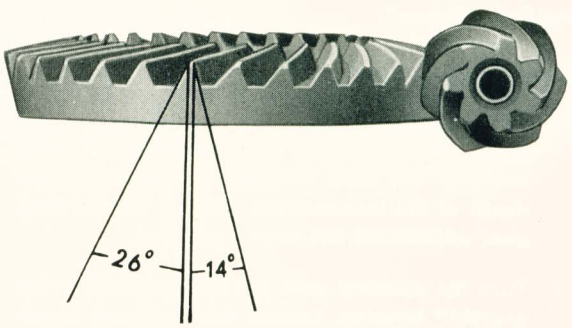
Difference between the old and the new sets

a - The drive pinion of the new Gleason gear set with its 30 mm (1.18″) is about 3.5 mm (.14″) longer than the earlier Gleason and the current Klingelnberg pinions.

b - The ring gear (crown wheel) with its 26.5 mm (1.04″) is about 1.5 mm (.06″) wider than that of the earlier types.

c - The tooth meshing angle is non-symmetrical. On the driving side it is 14 degrees and on the coasting side 26 degrees. The earlier Gleason and the current Klingelnberg gear sets have a symmetrical meshing angle. Therefore, the new Gleason set is distinguished from other sets by its "saw-tooth".





	m = 3.00	m = 3.25
Distinguishing mark (drive pinion face):	K	K
Distinguishing mark (ring gear):	None	V
Nominal dimension for "R" (distance from ring gear center line to drive pinion face):	59.22 mm (2.3315″)	59.22 mm (2.3315″)

Adjusting the Drive Pinion

Nos. of teeth	7	8
R	55.75	59.35

Checking Adjustment of Drive Pinion and Ring Gear

Make sure the axial adjustments of drive pinion and ring gear are correct by measuring the backlash and checking the tooth contact.

Preliminary Operations

1 - Place differential in left transmission case half, taking care that the two differential shims are fitted to the correct sides. The chamfered face of the shim must be toward the differential housing. If an additional shim of 0.25 mm is required, it should be fitted between ball bearing and other shim.

2 - Put drive pinion in place and tap it toward the ring gear by a light-metal hammer to take up any end play.

3 - Gleason toothing: Paint the teeth of the ring gear with a light paste made of dry red lead and engine oil.

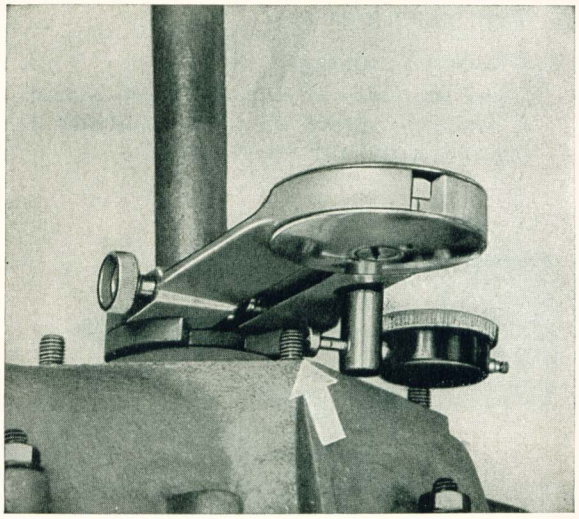
Klingelnberg toothing: Paint the teeth of the drive pinion with the aforementioned paste.

4 - Fit the right transmission case half and tighten it by six screws.

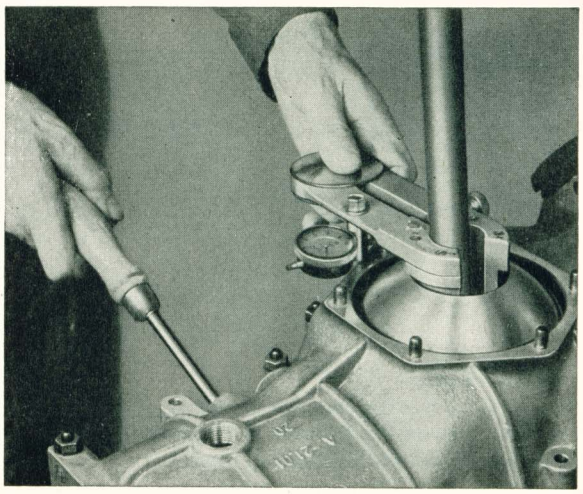
5 - Attach gearshift housing to transmission case (Note specified preload).

Measuring Backlash

1 - Insert the gauge VW 288b in the differential housing so that the tracer of the dial indicator contacts one of the studs for the axle tube retainer. Lock the gauge in this position.



2 - Prevent movement of the drive pinion and lightly move the gauge to take up the play in both directions. The amount of backlash will be indicated by the deflecting needle.



3 - Repeat the measuring several times, each time turning the ring gear 90°. The values measured must not differ from one another by more than 0.05 mm (0.002″). Compare the backlash measured with the amount of backlash written on the ring gear.

4 - An undue departure from the prescribed backlash should be corrected by altering the shims S 1 and S 2, but the total thickness of the shims must be maintened. Then recheck the backlash.

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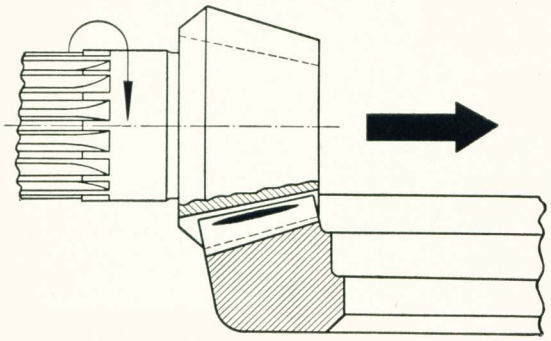
Checking Tooth Contact

1 - Rotate the differential and ring gear in both directions at the rear axle shafts.

2 - Open transmission case.

3 - Gleason Toothing

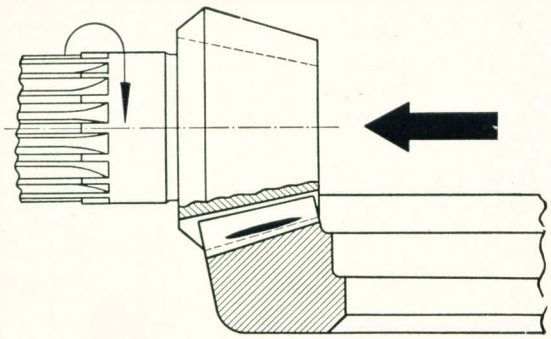
Check impression of **ring gear** tooth contact; if necessary, correct the axial adjustment as indicated below and repeat the test.



High tooth contact.

This condition is caused by the drive pinion being too far away from the ring gear and is corrected by increasing thickness of the pinion shims.

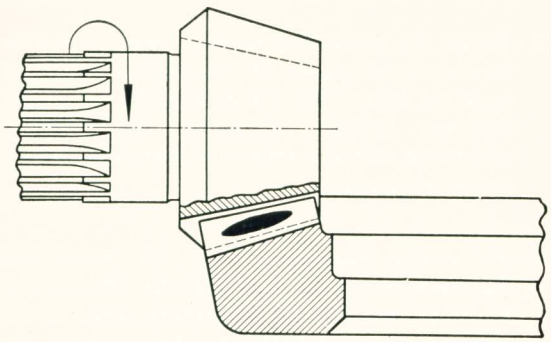
Recheck backlash and correct if necessary.



Low tooth contact.

This indicates that the pinion is too far in mesh with the ring gear. Reduce the thickness of the pinion shims.

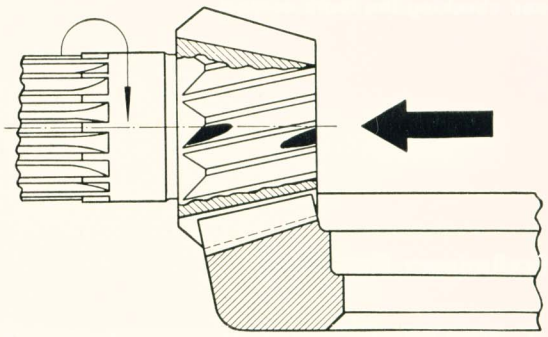
Recheck backlash and correct if necessary.



Proper tooth contact.

4 - Klingelnberg Toothing

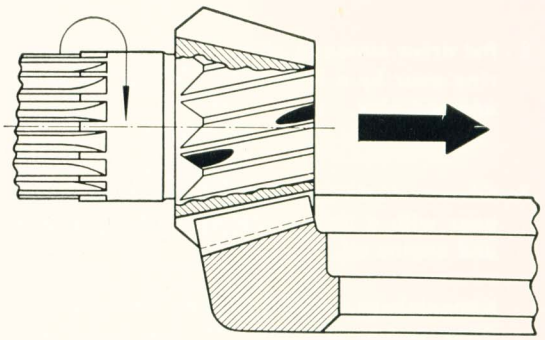
Check impression of **drive pinion** tooth contact; if necessary, correct the axial adjustment as indicated below and repeat the test.



Contact at larger diameter (driving side).

This indicates that the pinion is too far towards the ring gear. Reduce the thickness of the pinion shims.

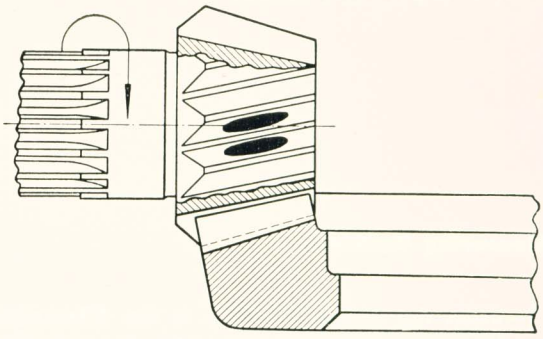
Recheck backlash and correct if necessary.



Contact at smaller diameter (driving side).

This condition is caused by the drive pinion being too far away from the ring gear and is corrected by increasing thickness of the pinion shims.

Recheck backlash and correct it if necessary.



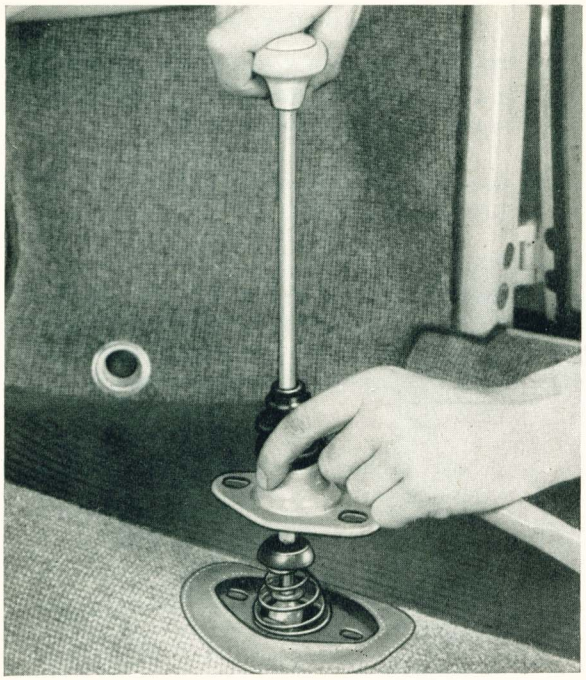
Proper tooth contact.

Removing and Installing Gearshift Lever

Removal

1 - Remove screws that attach the gearshift lever ball housing to the frame tunnel.

2 - Take off gearshift lever, spring, and stop plate.



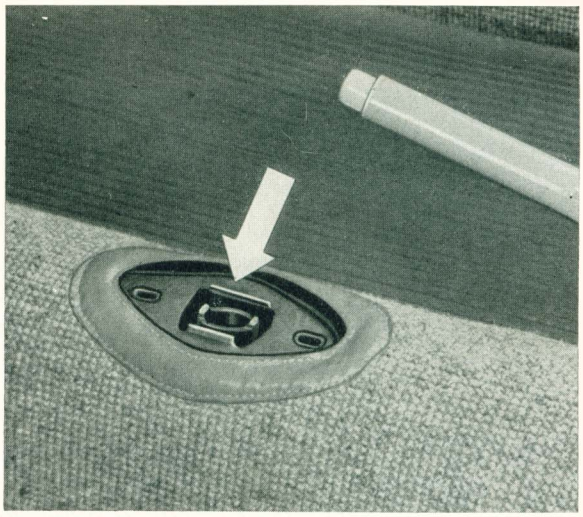
3 - Clean all components.

Installation

Reverse the above operations and observe the following points:

1 - Check gearshift lever, stop plate, and shifting rod end for wear. Replace worn parts.

2 - When installing stop plate, make sure that the turned up edge is on the right-hand side.



3 - Grease all moving parts with Universal Grease VW — A 052.

4 - The gearshift lever ball housing must occupy a position which insures that the gearshift lever stands vertical in neutral position. The stop plate must be embraced by the hollow flange of the ball housing.

5 - Check condition of gearshift lever rubber boot, replace it if necessary.

6 - Check position of gearshift lever by engaging the gears. If necessary, correct the position.

Removing and Installing Shifting Rod

Removal

1 - Remove gearshift lever.

2 - Remove rear seat.

3 - Remove inspection cover on frame tunnel.

4 - Remove lock wire at the coupling screws and release the front screw.

5 - Open front bonnet and remove spare wheel.

6 - Remove front bumper.

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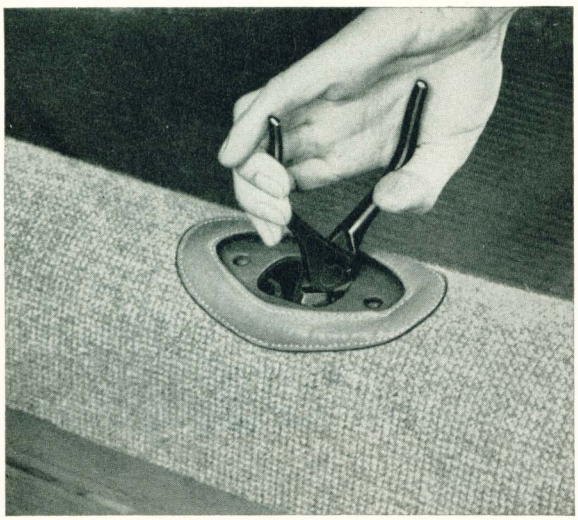
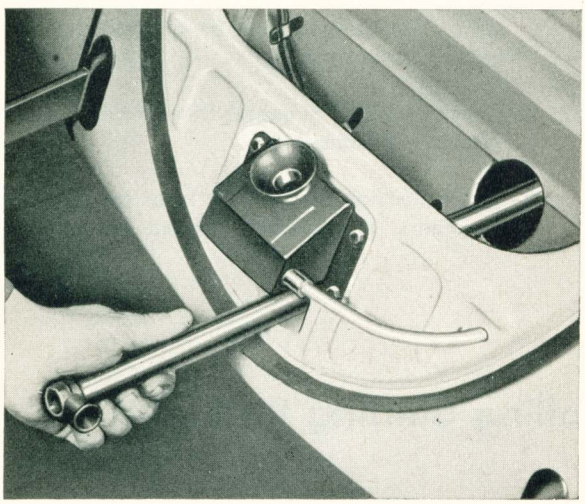
7 - Remove frame head cover.

8 - Unhook brake cables.
Remove guide plate for brake push bar after having removed the two screws.

9 - Withdraw shifting rod from the coupling, using combination pliers, and push it toward the front of the car as far as possible so that it can be gripped at the front by the pliers.



10 - Withdraw shifting rod through the openings in the body.



Installation

This is accomplished by reversing the above procedure, but attention should be paid to the following points:

1 - Check shifting rod for wear and twist. Wear may be caused by the leaf spring in the frame tunnel. Replace shifting rod if necessary.

The vertical end for accepting the gearshift lever and the recess for the coupling screw must be in line to avoid shifting difficulties.

2 - Grease the entire shifting rod with Universal Grease VW — A 052.

3 - Insert the shifting rod in the guide situated in the frame tunnel behind the opening for the gearshift lever. This operation is facilitated by the assistance of a second mechanic.

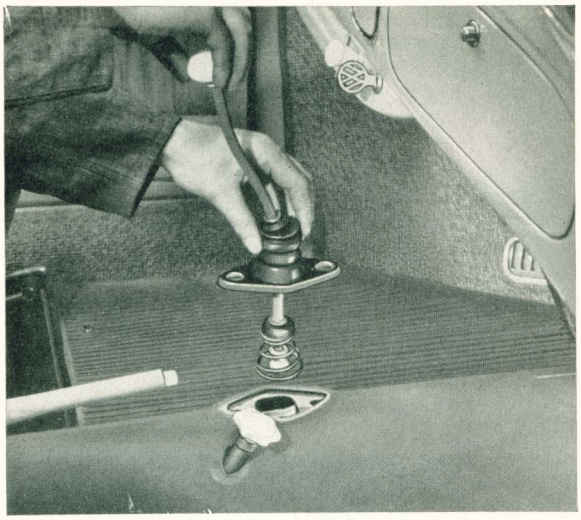
4 - Connect shifting rod coupling and secure with a piece of wire.

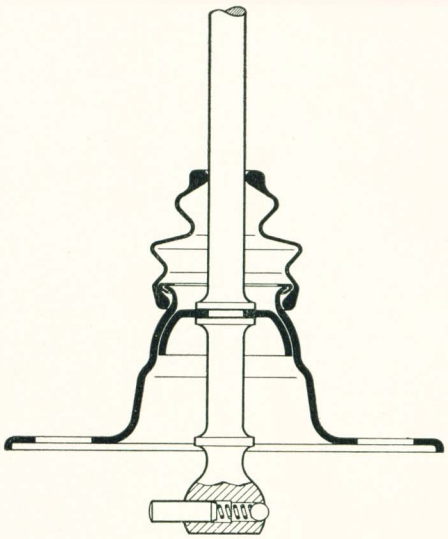
Gearshift Lever Removal and Installation

Removal

1 - Remove screws that attach the gearshift lever ball housing to the frame tunnel.

2 - Take off gearshift lever, ball housing, rubber boot, and spring as a unit. The spring should be turned for removal to clear the pin.

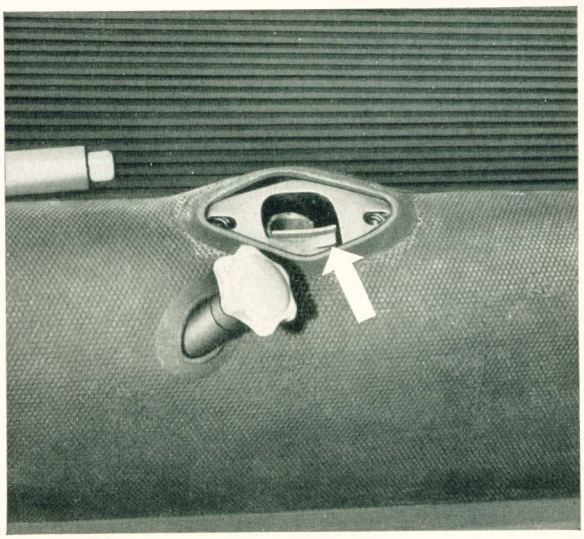




3 - When installing stop plate, make sure that the turned-up edge is on the right-hand side.

3 - Take off stop plate.

4 - Clean all components.



Installation

Reverse the above operations and observe the following points:

1 - Check gearshift lever collar, stop plate, and gearshift lever ball socket in shifting rod for wear. Replace worn parts.

2 - Make sure the gearshift lever locating pin is secure. Replace if necessary.

Note:

From Chassis No. 1—0948000 a modified gear lever has been installed.

The spring-loaded ball is to prevent a rattling noise of the gear lever in its socket.

Only this improved gear lever will henceforward be delivered by the Parts Department.

It has the same Part No. as the one in use from 4th August 1955 onwards and can only be exchanged for this.

4 - Grease all moving parts with Universal Grease VW — A 052.

5 - The gearshift lever ball housing must occupy a position which insures that the gearshift lever lower (straight) portion stands vertical in neutral position and the gearshift lever

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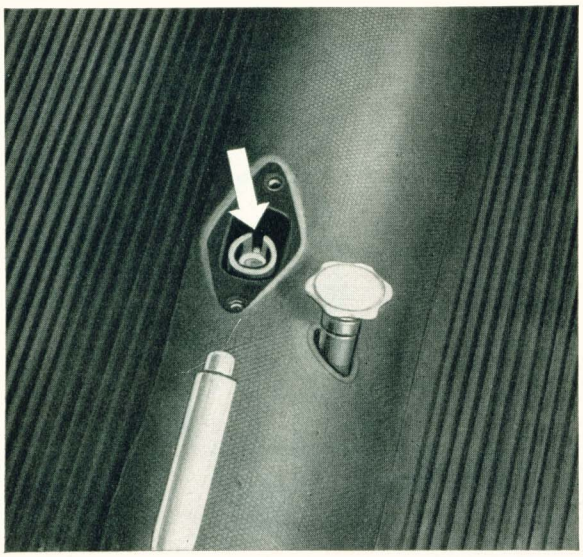
locating pin engages in the slot provided in the ball socket.



The stop plate must be embedded in the hollow flange of the ball housing.

6 - Check condition of gearshift lever rubber boot, replace if damaged.

7 - Check position of gearshift lever by engaging the gears. Correct if necessary.

Shifting Rod Removal and Installation

Removal

1 - Remove gearshift lever.

2 - Remove rear seat.

3 - Remove inspection cover on frame tunnel.

4 - Remove lock wire at the coupling screws and release front coupling screw.

5 - Open the front hood and take off spare wheel.

6 - Remove front bumper.

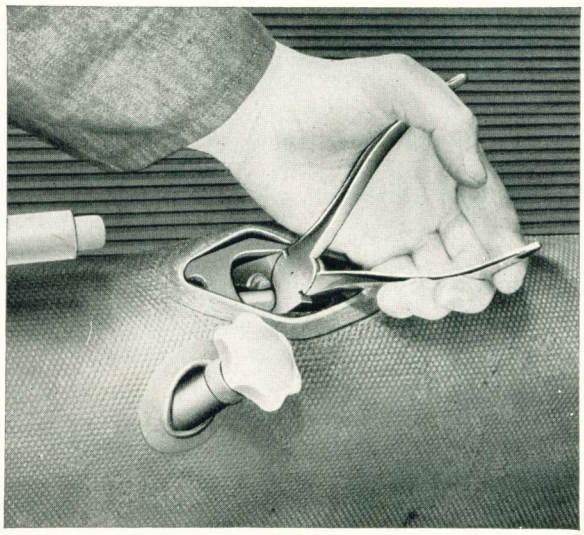
7 - Remove frame head cover.

8 - Withdraw shifting rod from the coupling, using combination pliers, and push it toward the front of the car as far as possible so that it can be gripped at the front with the pliers.

9 - Completely withdraw shifting rod through the openings in the body.

Installation

This is accomplished by reversing the preceding operations, but attention should be paid to the following points:



1 - Check shifting rod for wear and twist. Wear may be caused by the leaf spring in the frame tunnel. Replace shifting rod if necessary.

2 - Coat the entire shifting rod with Universal Grease VW — A 052.

3 - Insert the shifting rod in the guide situated in the frame tunnel behind the opening for the gearshift lever. This operation is facilitated by the assistance of a second mechanic.

General Description

The rear wheels are sprung independently. The inner ends of the two torsion bars are anchored in the center of the frame cross member by a splined tube which is welded in position. The outer ends of the torsion bars, which are also provided with splines, carry the spring plates, the hubs of which are rubber-cushioned. The rear axle tubes are attached to the rear ends of the spring plates. The suspension is adjustable by means of the splines. Double-acting telescopic shock absorbers prevent excessive rebound.

Removing and Installing Torsion Bar

Removal

1 - Loosen rear wheel mounting bolts.

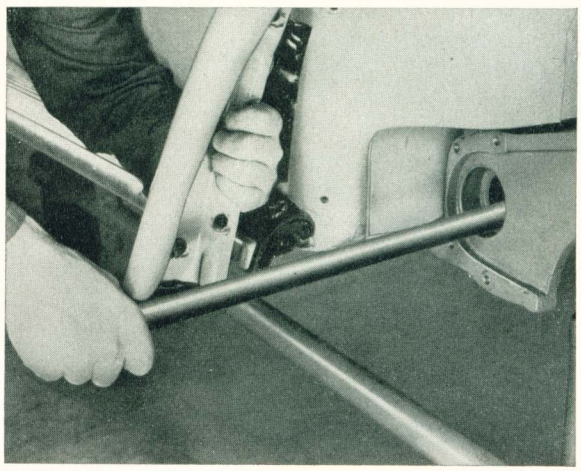
2 - Support car on trestles in a horizontal position and remove rear wheel.

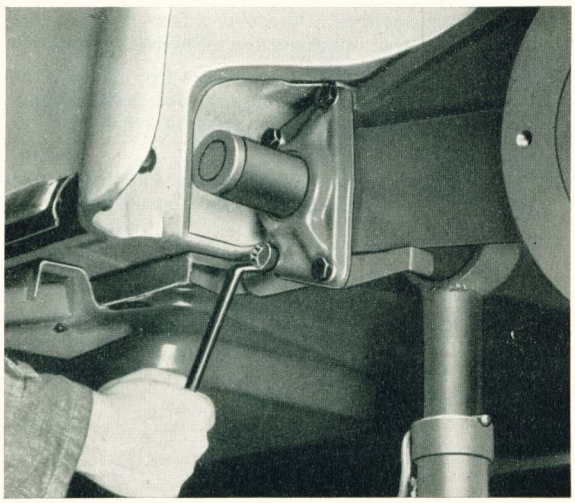
3 - Remove screws at rear axle shaft bearing housing for axle tube and shock absorbers.

4 - Pull rear axle towards the rear until it clears the spring plate.

5 - Take off torsion bar hub cap after having removed the cotter pin.

6 - Remove screws that attach spring plate hub cover and take off cover.





7 - Withdraw spring plate and both rubber cushions.

8 - Remove about five of the foremost fender screws.

9 - Withdraw torsion bar from frame cross member and at the same time pull the fender aside to allow the torsion bar to clear it.

Note:

In the case of a broken torsion bar, push the broken end from the splined center anchor by means of a steel rod after having removed the opposite torsion bar.

Installation

This is a reversal of the preceding operations, but the following points should be observed:

1 - Inspect torsion bar splined ends and paint for damage. Make sure there are no signs of rust, replace if necessary.

2 - Grease splines of torsion bar.

3 - Install torsion bar and spring plate and adjust them.

4 - Apply some graphite when installing rubber cushions.

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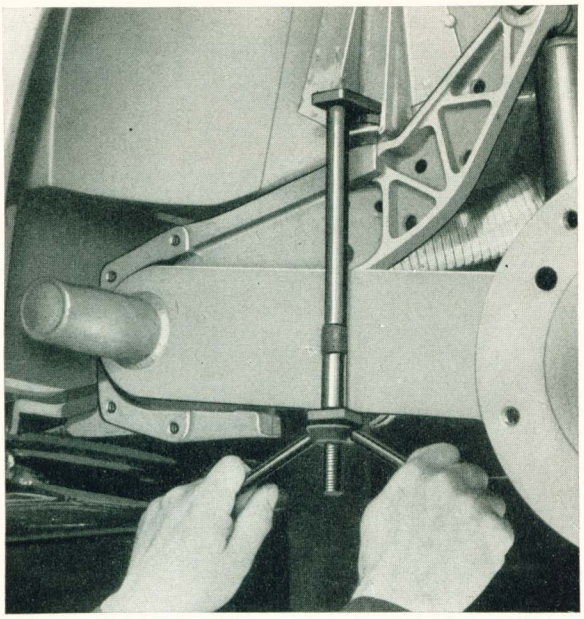
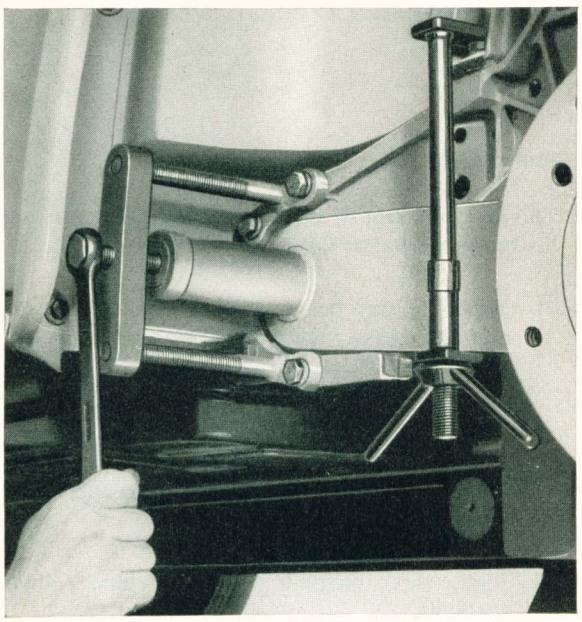
5 - Hook the torsion bar tensioner (Drawing for Local Manufacture VW 655) to the rear cross tube flange and push the sliding part of the tensioner upward against the lower edge of the spring plate. By turning the nut, lift the spring plate until its lower edge is higher than the lower stop on the cross tube flange.



6 - Screw the spring plate installing tool (Drawing for Local Manufacture VW 656) to the cross tube flange in place of the spring plate hub cover. Place the thrust pad on the spring plate hub and press in the spring plate by tightening the thrust screw.



7 - Remove the tools and install the spring plate hub cover.

Note:

To facilitate the installation of the hub cover and to avoid damage to the threads, it is recommended to screw two tapered guide pins (approx. 45 mm/1.8″ long) in two of the tapped holes, diagonally opposite. The cover is then pushed over the two guide pins, allowing two of the cover bolts to be screwed in. Afterward the two guide pins are removed and the two other bolts screwed in.

8 - Install torsion bar hub cap (where present) and secure it with a split pin.

9 - Clean mating faces between spring plate and axle bearing housing (traces of paint and rust). Tighten screws for axle bearing housing and shock absorber to a torque of 10—12 mkg (80—87 ft. lbs.).

Note:

Because of the modified torsion bar anchor in the frame, the splines at the anchor end of the torsion bars have been shortened from Chassis No. 1600440.

Torsion bars of new design (part No. 111511111 A) can be installed in frames of previous design. Torsion bars of previous design can also be installed in new frames.

After old stocks have been used up only torsion bars of new design will be available as spare parts.

Shock Absorbers

Correctly operating rear shock absorbers are, beside a proper adjustment of the spring plates, of great importance to a perfect suspension and road-holding of the car. The shock absorber prevents the spring plate striking the lower stop at the cross member flange during rebound.

It is permissible to use shock absorbers of different manufactures on one rear axle, if they are similar in fundamental design, operation, and adjustment.

Attention!
The telescopic shock absorbers for the Volkswagen or Transporter Front Axle should, on account of their different operating characteristics, never be fitted to the VW Rear Axle.

Maintenance

The shock absorbers require no maintenance attention. If only a slight loss of fluid has taken place and the function of the shock absorber is still satisfactory, there is no need for an exchange, as an adequate fluid reservoir compensates smaller losses.

Worn parts of the shock absorber mounting are to be replaced after the shock absorber has been removed, using Repair Press VW 400 and the press tools VW 401, VW 410, VW 421, VW 436, VW 437 and VW 438.

Inspection

As both the compression and rebound actions of the shock absorbers correspond to the springing characteristics of the car, no attempt should be made to disturb the adjustment or to fit shock absorbers of other characteristics. The riding qualities would otherwise be seriously affected. Shock absorber action may be roughly checked by bouncing each corner of the car in turn or by riding the car over a strongly uneven road. A more accurate check can be made by means of special testing appliances which are generally not available at the shop. A check by compressing the removed shock absorber by hand will only give an indication whether or not there is a resistance, the degree of efficiency of the compression and rebound strokes cannot be determined by this method.

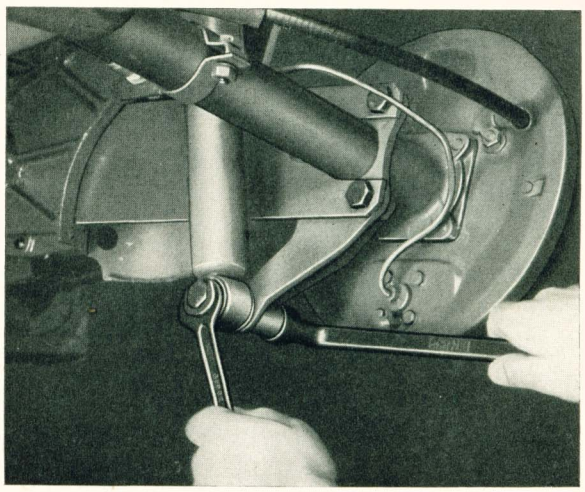
Removing and Installing Shock Absorbers

Removal

1 - Lift the car.

2 - Remove cotter pins and nuts of mounting.

3 - Remove shock absorbers.



Installation

Reverse the preceding operations and observe the following points:

1 - Test shock absorbers and, if necessary, replace.

2 - Inspect bushes and rubber bearings for wear.

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Description of Rear Axle

(Standard)

H

General Description

Transmission, rear axle and engine are combined in the rear of the car. The rear axle is of the swing half axle type. The rubber-cushioned transmission case is secured to the frame at three points. It incorporates the transmission and the differential.

Transmission Case

The bipartite transmission case is cast of light alloy. It must be clearly understood that when replacements are necessary it is not permissible to replace a single half of the transmission case. These are machined in pairs to very close limits and in consequence replacements must be made in pairs.

Transmission

The transmission has four speeds forward and one reverse provided with a stop. The helical 3rd and 4th speed gears are in constant mesh and insure quiet operation.

Gear ratios:

1st	3.60 : 1
2nd	2.07 : 1
3rd	1.25 : 1
top	0.8 : 1
reverse	6.6 : 1

Gear Control

The shifting rod in the frame tunnel links the transmission to the gearshift lever which is located on the tunnel. 1st and 2nd speeds and reverse are brought into engagement by sliding gears. When shifting to 3rd or top speed, the nine pins bedded in the guide sleeve on the drive pinion engage with the holes provided in the gears.

Final Drive

Power is transmitted through a helically-cut drive pinion and ring gear (crown wheel), provided with differential bevel gears, via two swinging axles to the rear wheels. Silent operation and a long service life of the final drive mechanism are only insured by carefully adjusting drive pinion and ring gear.

Gear ratios:

Klingelnberg toothing	4.43 : 1
Gleason toothing	4.37 : 1

The differential is to compensate the difference of wheel travel as the car makes a turn, thus maintaining an equal drive of the wheels.

Rear Suspension

The rear wheels are sprung independently. Road shocks are transmitted to the left or right torsion bar by a spring plate on either side of the rear axle. The torsion bars are supported in the center of the cross tube and secured against twisting by a spline engagement.

An accurate adjustment of the rear wheel suspension is effected by means of the splines cut in both ends of each torsion bar in different numbers. Hydraulic double-acting shock absorbers of the telescopic design dampen road shocks and prevent excessive rebound.

Oil Capacity

The oil capacity of the transmission case is 2.5 liters (5.3 U. S. pints; 4.4 Imp. pints). The oil should be changed at intervals indicated in the Lubrication Chart, using oil of the proper specification. When changing oil, the transmission case should be refilled with 2.0 liters (4.2 U. S. pints; 3.5 Imp. pints).

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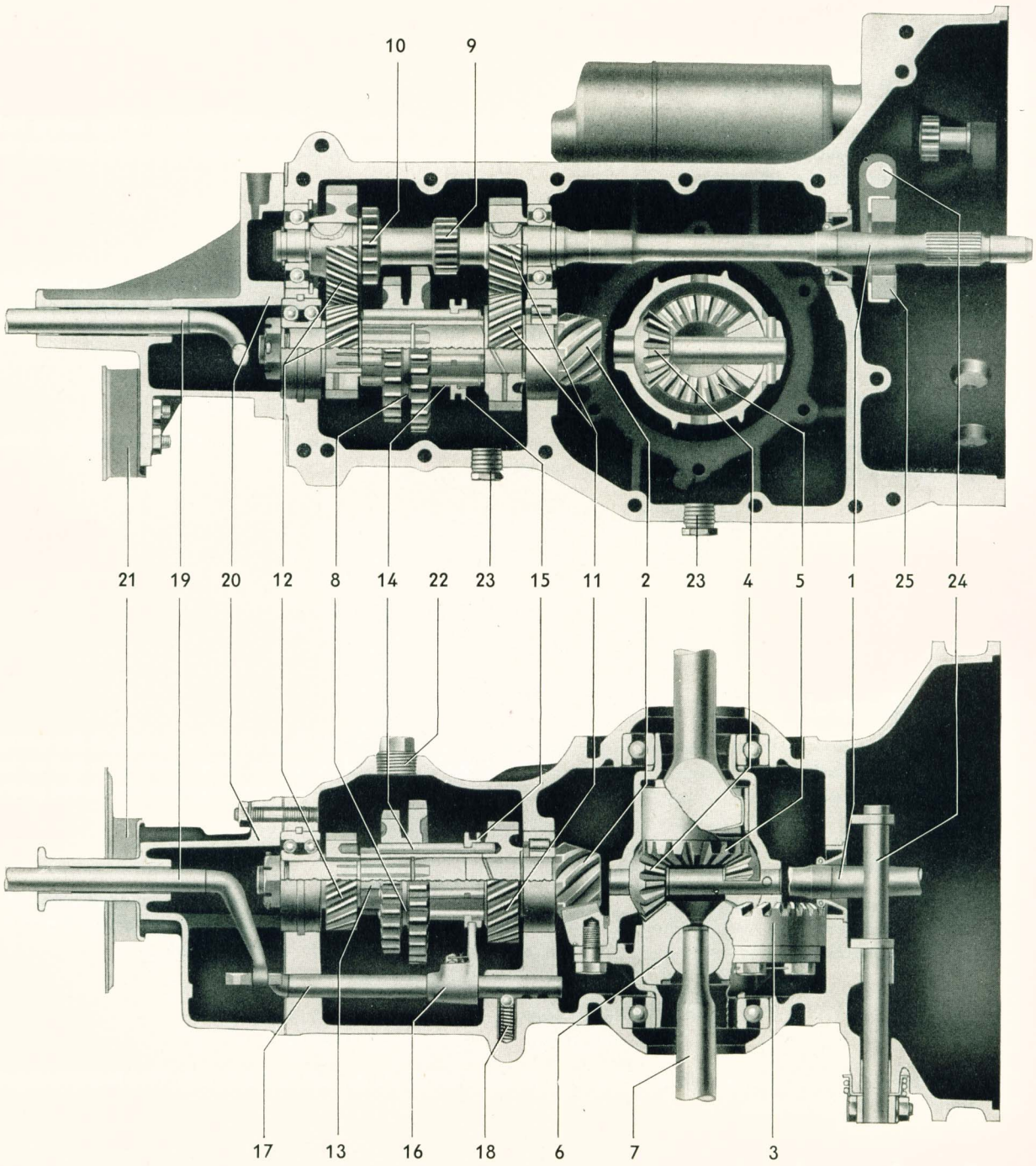


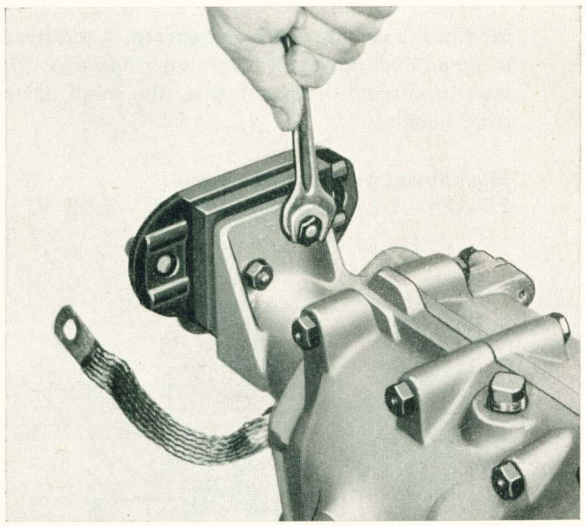
Volkswagen — Rear Axle and Standard Transmission
(Sectional View)

1 - Main Drive Shaft
2 - Drive Pinion
3 - Ring Gear (Crown wheel)
4 - Differential Pinion
5 - Differential Side Gear
6 - Fulcrum Plate
7 - Rear Axle Shaft
8 - 1st and 2nd Speed Sliding Gear
9 - 1st Speed Gear
10 - 2nd Speed Gear
11 - 3rd Speed Gears
12 - 4th Speed Gears
13 - Guide Sleeve
14 - Engaging Pin
15 - Selector Ring (Gearshift ring)
16 - Selector Fork (Gearshift fork)
17 - Selector Shaft (Gearshift rail)
18 - Detent Spring and Ball
19 - Transmission Shift Rod
20 - Gearshift Housing
21 - Rubber Cushion
22 - Oil Filler Plug
23 - Oil Drain Plug
24 - Clutch Operating Shaft

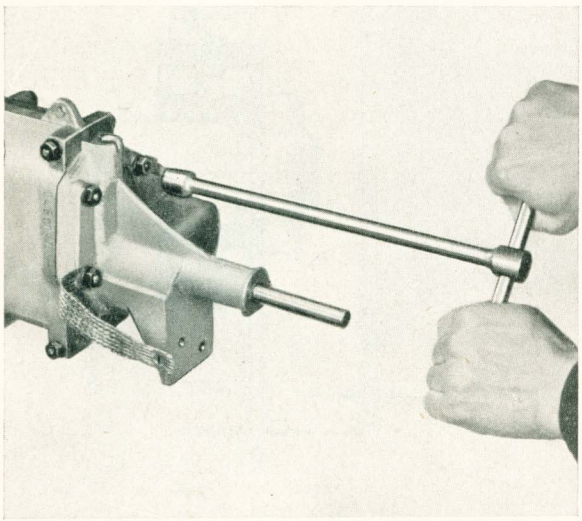
Removing and Installing Gearshift Housing

Removal

1 - Remove nuts that attach the rubber cushion to the gearshift housing.



2 - Remove gearshift housing nuts and take off ground copper braid.



3 - Take off gearshift housing and transmission shift lever.

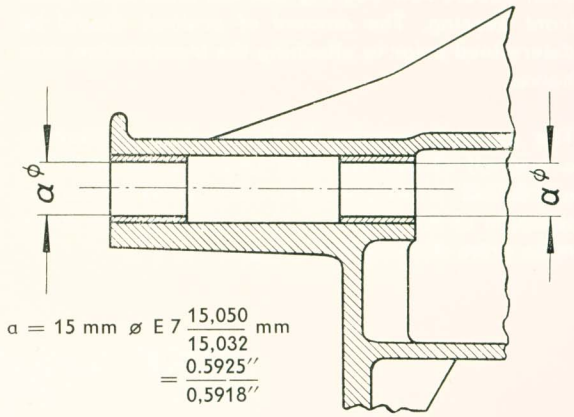
4 - Remove gasket and clean jointing faces.

Installation

This is accomplished by reversing the removal procedure, but the following hints should be observed:

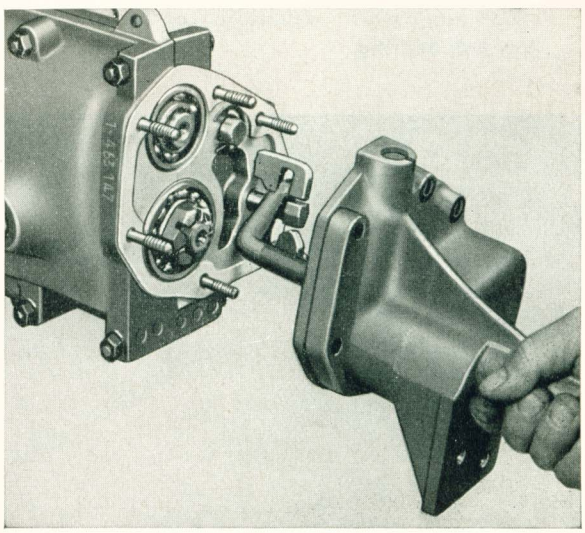
1 - Inspect transmission shift lever bushes. Worn bushes must be replaced by using the Repair Press VW 400 in conjunction with VW 401, 412, and 439. The bushes are to be reamed up to

$$\frac{15.050}{15.032}\ \text{mm} = \frac{0.5925''}{0.5918''}$$



2 - Note thicknesses of gasket and paper ring between gearshift housing and transmission case to insure that the ball bearings are correctly preloaded. Excessively preloaded ball bearings may cause noise and premature wear.

3 - Make sure the three selector shafts are in neutral position when attaching the gearshift housing.



4 - Connect ground copper braid to the correct stud.

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Preload on Transmission Ball Bearings

The assembly of the transmission case includes a careful consideration of the preload on the drive shaft double row bearing and the main drive shaft front bearing. The amount of preload should be determined prior to attaching the transmission case halves.

The gearshift housing is tightened in position to a preload of between 0.02 and 0.11 mm (0.0008″ and 0.0043″). The preload is obtained by the correct selection of the gasket or the retaining ring at the main drive shaft front bearing.

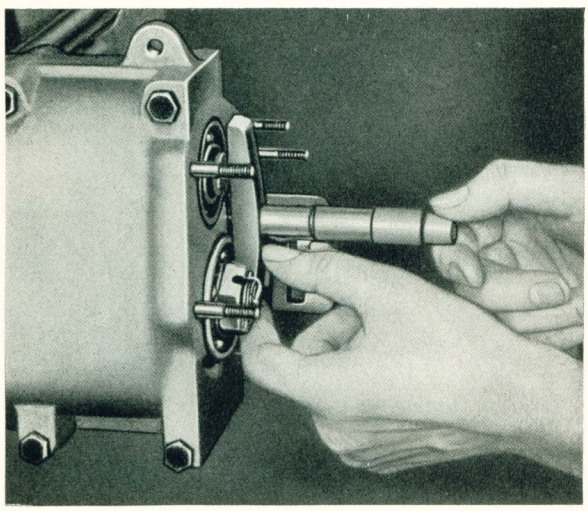
How to Determine Preload

Before measuring, any end play of the drive pinion and main drive shaft should be eliminated by light taps with a mallet. The measuring should, if possible, be done with a depth micrometer.

The following dimensions should be checked:

a - Dimension D, distance from drive pinion bearing to matching face of transmission case.

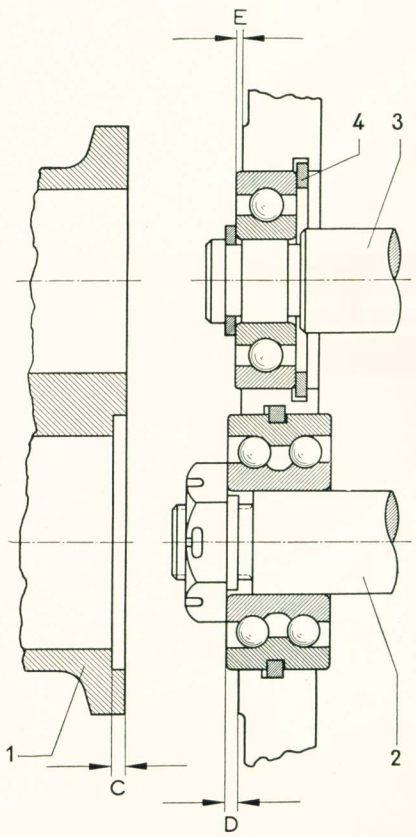
Dimension C, depth of recess for drive pinion bearing. The difference between D and C is to be compensated by the selective fitting of the gasket to insure the prescribed preload (0.02—0.11 mm/0.0008″—0.0043″) on the double row ball bearing.



b - Dimension E, distance from main drive shaft bearing to matching face of transmission case.

This bearing must be subject to the same preload as the double row ball bearing. A selection of three thicknesses of retaining rings is available to correct the preload on the main drive shaft bearing.

Thicknesses of retaining ring:
2.0—2.1—2.2 mm (0.079″—0.083″—0.087″).



1 - Gearshift housing
2 - Drive pinion
3 - Main drive shaft
4 - Retaining ring

C - Depth of recess for double row ball bearing in gearshift housing.

D - Distance from double row ball bearing to transmission case matching face.

E - Distance from main drive shaft ball bearing to transmission case matching face.

Example:

a - Dimension D	3.60 mm
Dimension C	3.30 mm
Difference	0.30 mm
Dimension for preload	— 0.10 mm
Thickness of gasket	0.20 mm

b - Dimension E	0.20 mm
Thickness of gasket	— 0.20 mm
Preload on main drive shaft ball bearing	0 mm

To obtain the required preload, the thickness of the ball bearing retaining ring must be increased by 0.1 mm.

Disassembly and Assembly of Transmission Case

The two transmission case halves are machined in pairs to very close limits and in consequence replacements must be made in pairs. It is not necessary to replace the gearshift housing together with the transmission case. After the matching faces have been cleaned, they must be lightly coated with sealing compound. A replacement of the transmission case necessitates a readjustment of the preload on the differential ball bearings by a selective fitting of shims.

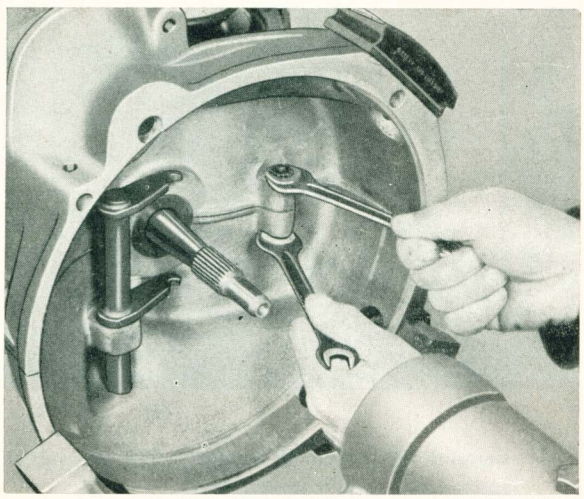
Note. — The Rear Axle Number is stamped on the right transmission case half at the gearshift housing jointing flange.

Disassembly

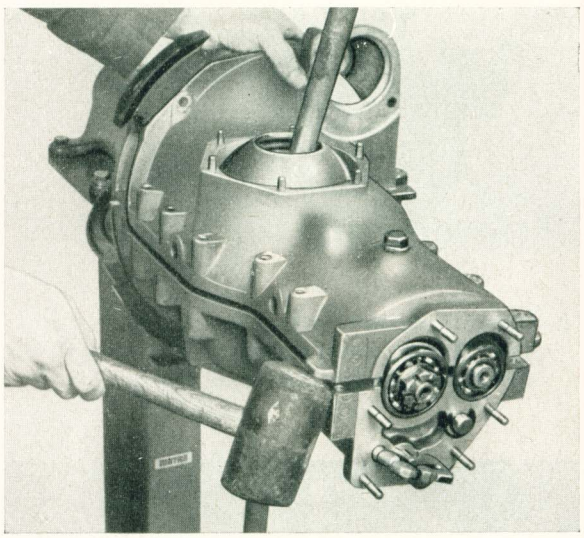
1 - Remove gearshift housing.

2 - Remove clutch release bearing and disconnect clutch operating lever return spring.

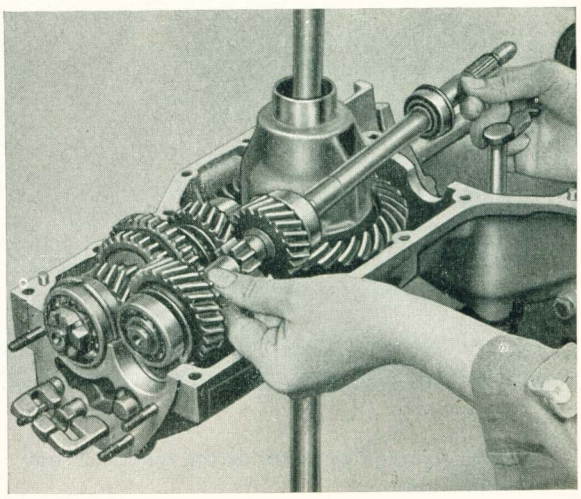
3 - Remove screws at transmission case matching faces and clutch cable supporting bracket.



4 - Turn the transmission case and take off right transmission case half.



5 - Lift complete main drive shaft and drive pinion from left transmission case half.



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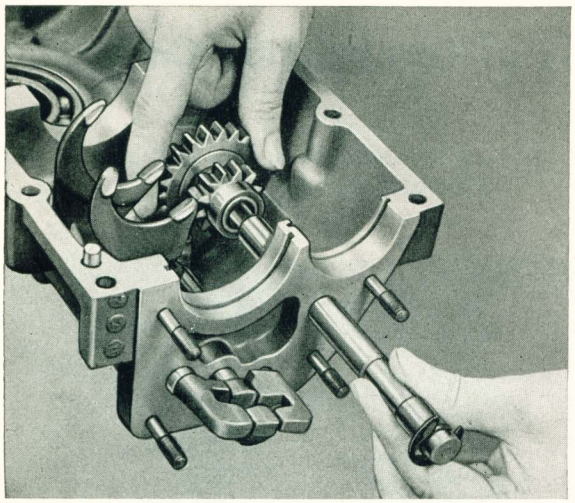
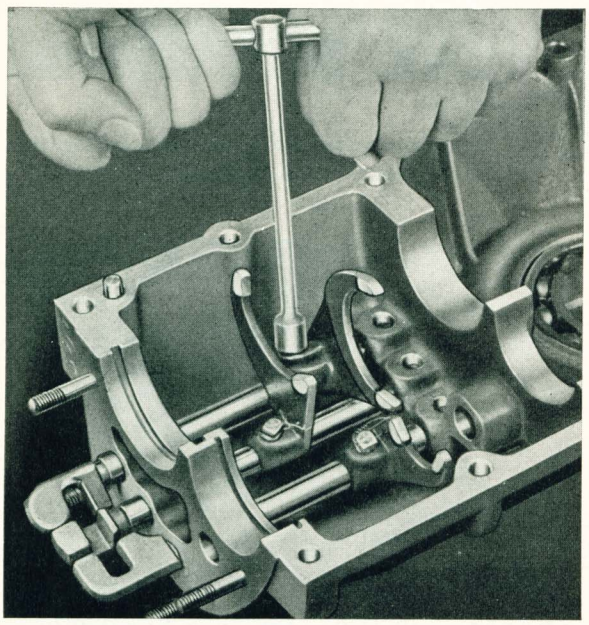
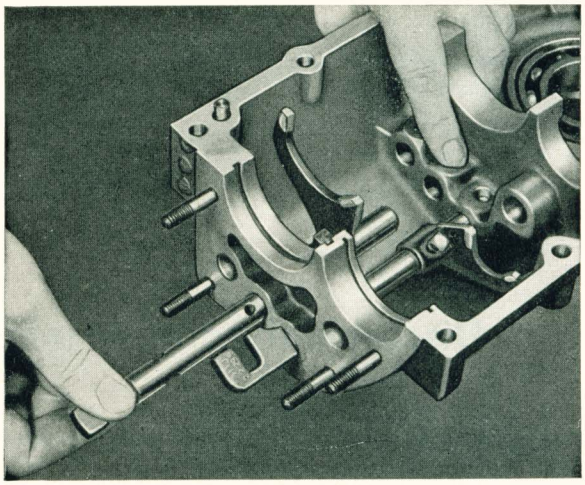
6 - Drive out differential and rear axle shafts from the left transmission case half by means of a mallet. Note arrangement of the differential shims to assure proper installation at assembly.

7 - Remove reverse sliding gear shaft and reverse sliding gear.



8 - Remove selector fork screws with Wrench VW 114 after having removed the locking wire. Withdraw selector shafts and prevent detent balls to jump off by covering the holes. Lift out selector forks.

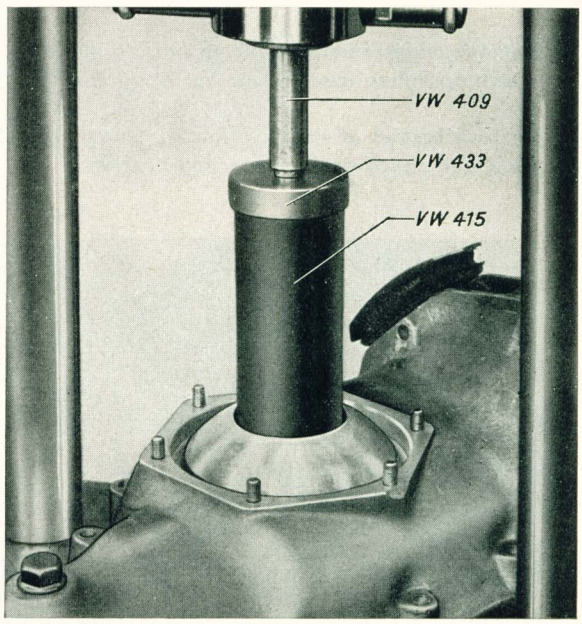




9 - Remove detent balls and springs.

10 - Take out the two selector shaft interlock plungers.

11 - Remove the differential ball bearings, using extractor VW 290b or Repair Press VW 400 in conjunction with VW 409, VW 415, and VW 433.



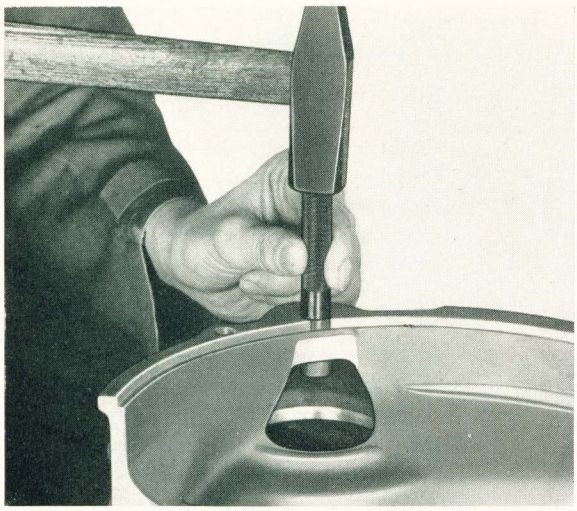
12 - Remove clutch operating shaft and lever, return spring and return spring seat.

Assembly

This is effected by reversing the preceding operations, but the following points should be noted:

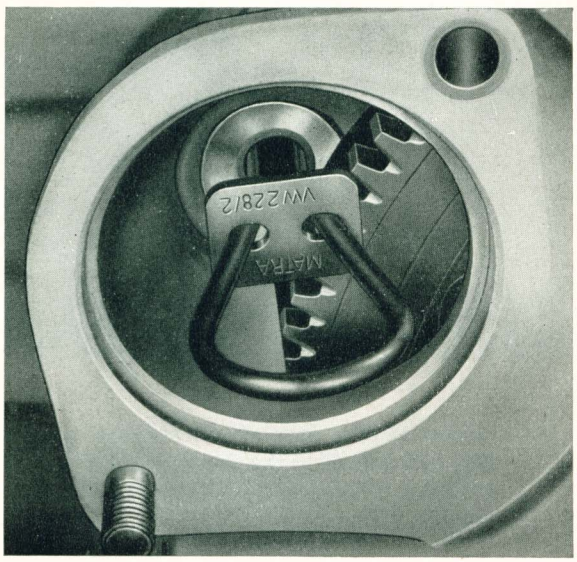
1 - Thoroughly clean transmission case and check it for wear, external damage and cracks; replace it if necessary.
In the case of the drive pinion or ring gear (crown wheel) being damaged (e. g., breakage), check the bores in the transmission case webs for alignment; replace transmission case if necessary.

2 - Check starter shaft bush for wear, using plug gauge VW 246. If necessary, replace the bush by means of drift VW 222 or Repair Press VW 400 in conjunction with VW 401, VW 408 and VW 438.



Note. — Replacement of starter shaft bush with engine in situ:

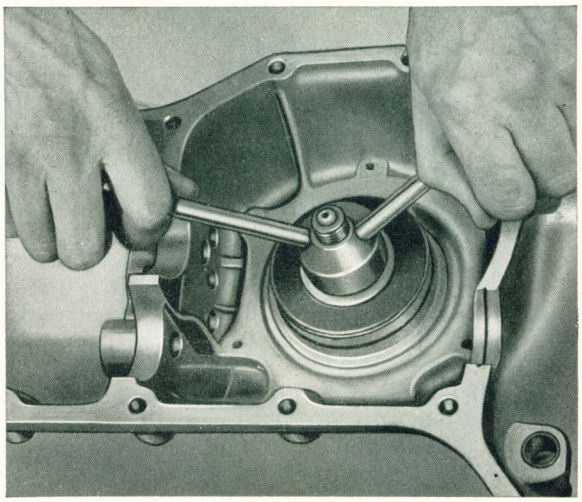
Removal with extractor ..... VW 228
Installation with drift ..... VW 222



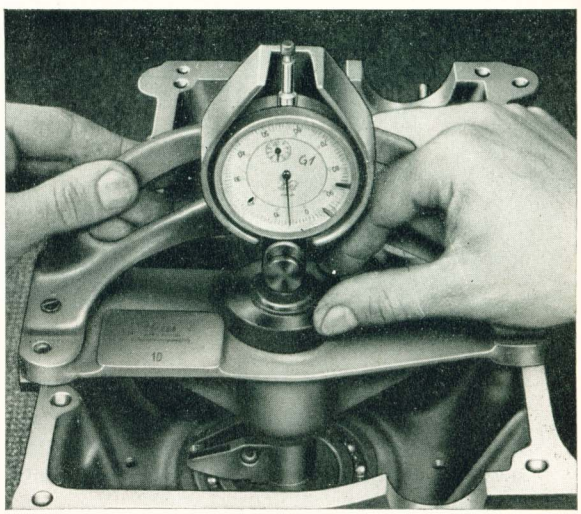
3 - Check clutch operating shaft bushes for wear, replace as necessary.

Important!
The clutch operating shaft must in all cases be installed before the transmission case halves are screwed together.

4 - Press the differential ball bearings in place, using Special Tool VW 290a or Repair Press VW 400 in conjunction with VW 401, VW 409, VW 415 and VW 433.



Check square seating of ball bearings by means of gauge VW 285, the permissible tilt being 0.02—0.04 mm (0.0008''—0.0016'').



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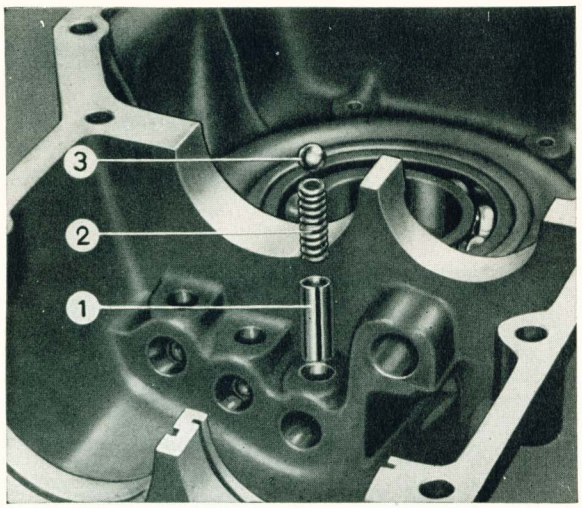
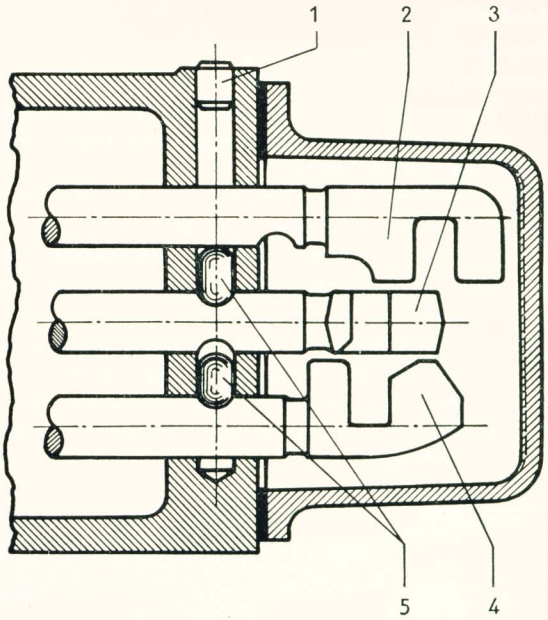
5 - Examine detent springs and replace as necessary. Free length of detent spring: 25 mm (1″); wear limit: 23 mm (0.9″). The force applied to overcome the detent ball undercuts on the selector shafts should amount to approx. 20 kg (45 lbs.).

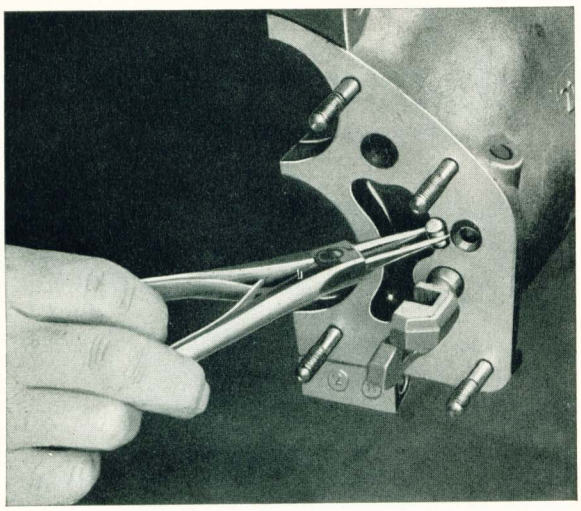


1 - Guide sleeve 2 - Detent spring 3 - Detent ball

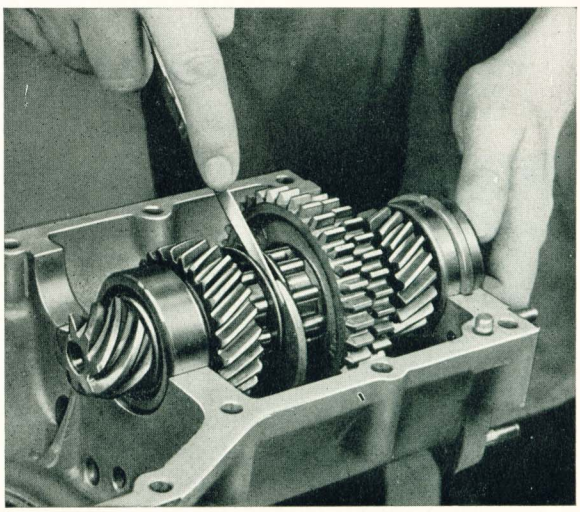


1 - Plug for interlock plunger channel
2 - Selector shaft for reverse
3 - Selector shaft for 1st and 2nd gears
4 - Selector shaft for 3rd and 4th gears
5 - Interlock plungers

6 - Install selector shafts in the order 3rd/4th gears, 1st/2nd gears and reverse, taking care not to omit the two interlock plungers. Check for proper interlocking by engaging a gear. The selector shaft next to the one used must be locked. When engaging 1st or 2nd gears (center selector shaft), the two other selector shafts should be locked.



7 - Check selector forks for wear. The clearance between selector forks and selector ring should not be in excess of 0.53 mm (0.021″). Replace worn parts.



8 - Tighten selector fork screws, making sure that they properly fit in the corresponding recesses provided in the selector shafts and the secure them by means of wire.

9 - Examine reverse sliding gear bush and reverse sliding gear shaft; if necessary, replace as follows:

Press out the bush on Repair Press VW 400 in cunjunction with VW 401, VW 409 and VW 420 and install it in conjunction with VW 401, VW 412 and VW 420. Peen the bush securely in position and ream it up to

$$\frac{16.093}{16.050}\ \text{mm diam.} = \frac{0.6336''}{0.6319''}$$

10 - Inspect differential and replace worn or damaged components.

Be sure that the differential shims occupy their original positions.

Attention!

VW Passenger Cars: Ring gear (crown wheel) is in left transmission case half

VW Transporter: Ring gear (crown wheel) is in right transmission case half

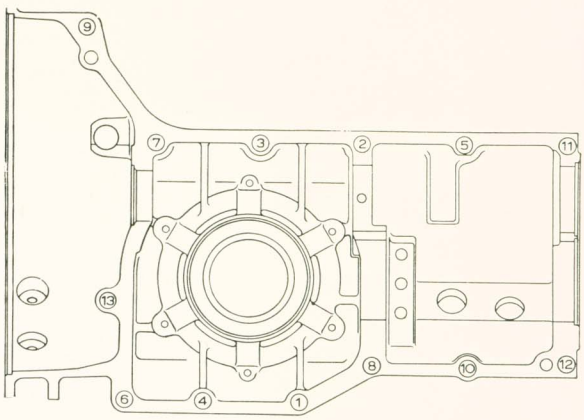
11 - Inspect drive pinion, main drive shaft, and oil seal; replace worn or damaged parts. Oil the contact surface of the oil seal lip before sliding the oil seal on the main drive shaft.

Care must be taken to see that the ball bearing retaining ring is bedding correctly in the provided ring groove.

12 - Before attaching the transmission case halves, check the gearshifting and proper meshing of all gears.

13 - Clean all jointing faces and oil seal seatings and lightly coat them with Sealing Compound D 1 a prior to assembly.

14 - Tighten transmission case screws in the below indicated order to a torque of 2 mkg (15 ft. lbs.).



15 - Connect clutch operating lever return spring after the clutch release bearing has been fitted.

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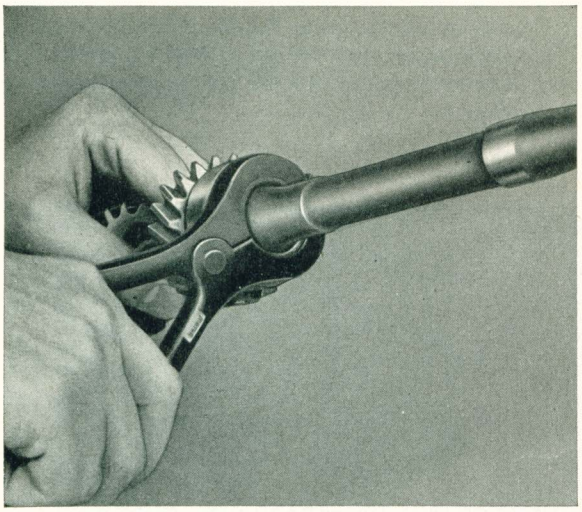
Reconditioning Main Drive Shaft

Disassembly

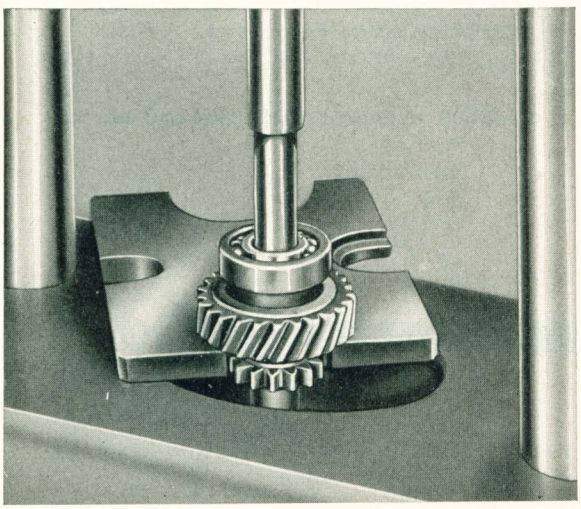
1 - Disassemble transmission case and lift out main drive shaft.

2 - Remove ball bearing retaining ring at third speed gear, using tool VW 161 a.



3 - Remove ball bearing retaining ring at fourth speed gear.

4 - Remove fourth speed gear, retaining ring and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 408.



5 - Remove third speed gear and ball bearing by means of the Repair Press VW 400 in conjunction with VW 401 and VW 412.

6 - Take off the keys in the main drive shaft.

7 - Clean the main drive shaft, especially its center holes.

Inspection

1 - Check main drive shaft for wear:

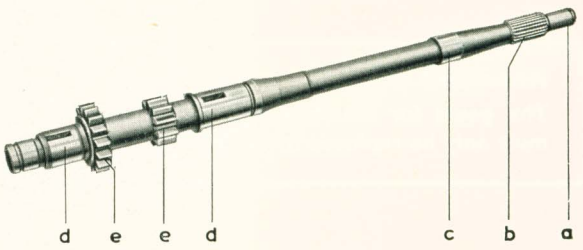
a - Check pilot for flywheel gland nut bush for wear.

b - Check splines for wear (radial clearance).

c - Check oil seal seating for scores and signs of wear.

d - Make sure that the ball bearings and gears (3rd and 4th speeds) are a press fit on their seats.

e - Check first and second speed gears for wear and damage.



a - Pilot
b - Splines
c - Oil seal seat
d - Seat (3rd and 4th gears)
e - Gears for 1st and 2nd speeds

Excessive wear, damage or excessive play necessitate a replacement of the main drive shaft. If the gears for the 1st and 2nd speeds are found to be excessively worn, the corresponding sliding gear on the drive pinion should also be checked and, if necessary, replaced.

2 - Check main drive shaft for run-out. Place main drive shaft between two points and check at intermediate seat. Permissible run-out: max. 0.05 mm (0.002''). If the run-out is in excess of this limit, the main shaft may be straightened in cold condition.

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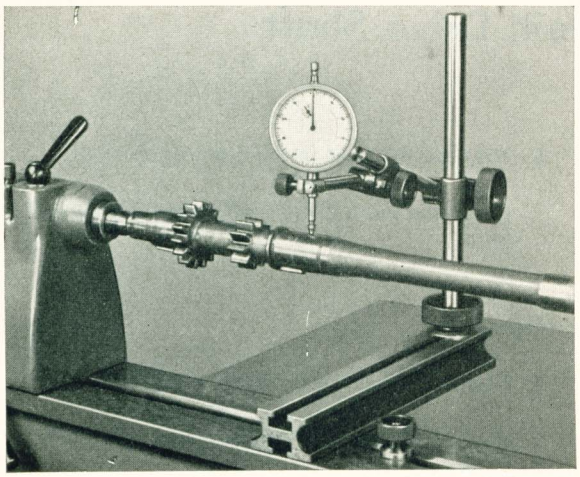


Note. — With the main drive shaft installed in the transmission case, the run-out (max. 0.2 mm/0.008″) should be measured at the pilot.

3 - Inspect ball bearings for wear and damage, replace as necessary.

4 - Check third and fourth speed gears for wear and damage, replace as necessary.

Attention!
The gears for the third and fourth speeds must only be replaced in pairs.

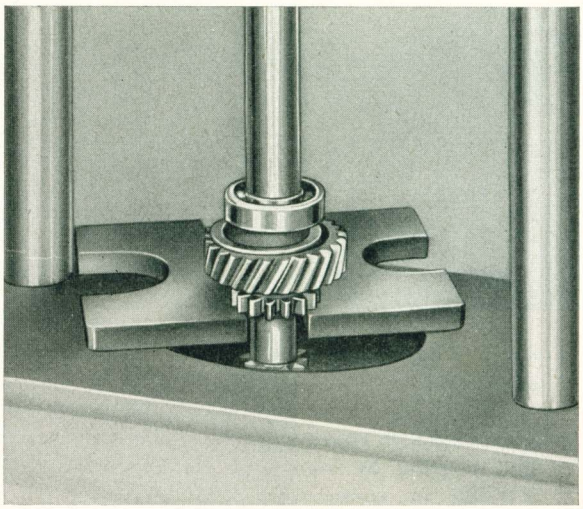
Assembly

This is effected by reversing the disassembly procedure, but the following points should be observed:

1 - Place the two keys in position.

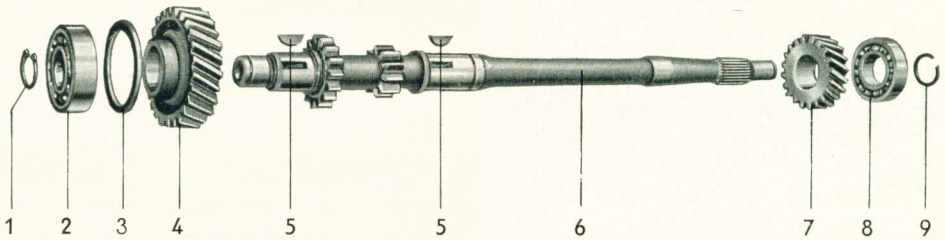
Important!
Before pressing the gears and ball bearings in place, they must be heated to approx. 80° C (180 °F) in an oil bath. Gears and ball bearings must be a press fit on the main shaft.

2 - Press fourth speed gear and then the ball bearing in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 420. Do not forget to refit the ball bearing retaining ring.



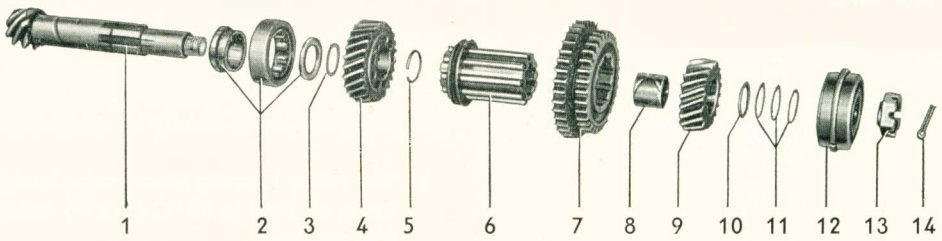
3 - Press third speed gear and then the ball bearing in place, using Repair Press VW 400 in conjunction with VW 401, VW 412 and VW 419.

4 - Install retaining rings for the ball bearings.



1 - Retaining ring
2 - Ball bearing
3 - Retaining ring
4 - 4th speed gear
5 - Keys
6 - Main drive shaft
7 - 3rd speed gear
8 - Ball bearing
9 - Retaining ring

Reconditioning Drive Pinion



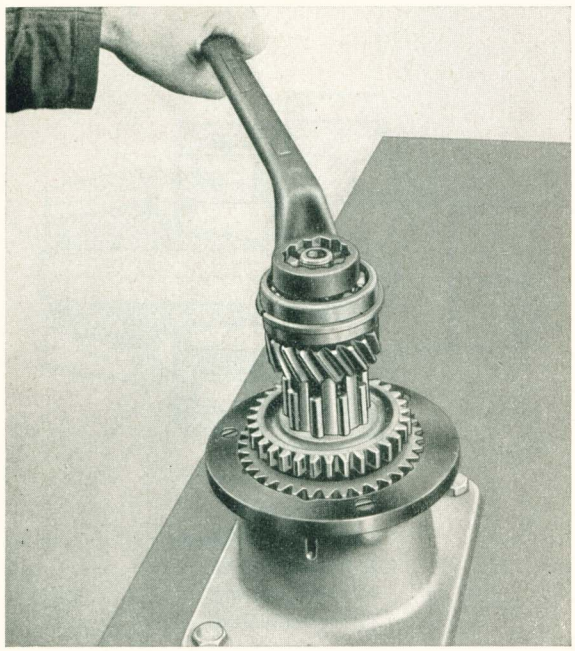
1 - Drive pinion
2 - Roller bearing
3 - Retaining ring
4 - 3rd speed gear
5 - Retaining ring
6 - Guide sleeve with engaging pins and selector ring
7 - Sliding gear for 1st and 2nd speeds
8 - Bush
9 - 4th speed gear
10 - Spacer
11 - Shims
12 - Double row ball bearing with retaining ring
13 - Nut
14 - Cotter pin

Disassembly

1 - Open transmission case and lift out drive pinion.

2 - Place drive pinion in holding fixture VW 314.

3 - Remove cotter pin and screw off the nut.



4 - Remove double row bearing on Repair Press VW 400 in conjunction with VW 402 and VW 408.

5 - Take off spacer and shims.

6 - Take off fourth speed gear and bush.

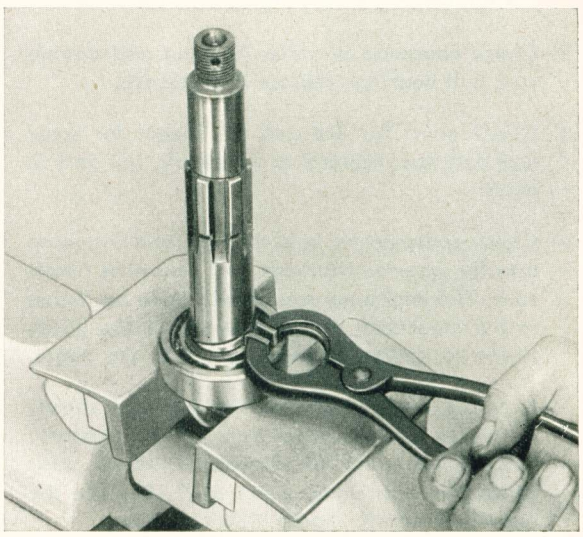
7 - Remove sliding gear for first and second speeds.

8 - Remove guide sleeve, engaging pins, and selector ring.

9 - Remove guide sleeve retaining ring.

10 - Take off third speed gear.

11 - Remove roller bearing retaining ring, using tool VW 161 a.



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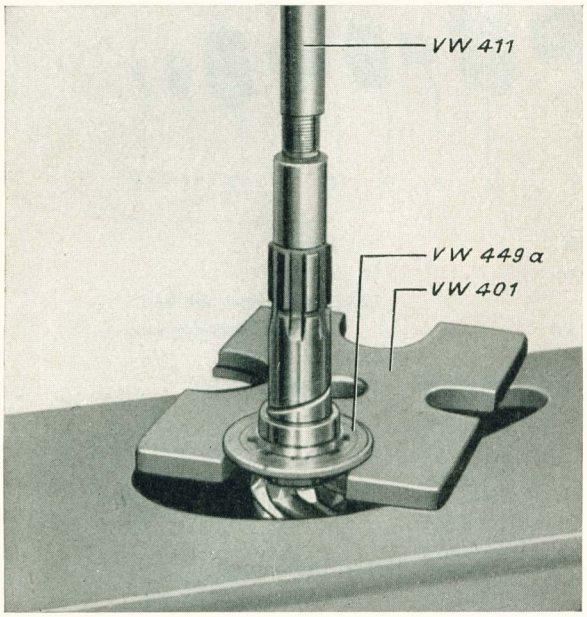
12 - Extract roller bearing

a - Klingelnberg toothing (7 teeth). Use Repair Press VW 400 in conjunction with VW 401, 411, and 449a.



b - Gleason toothing (8 teeth). Use Repair Press VW 400 in conjunction with VW 401, 411, and 449b.

13 - Clean drive pinion. The oil passages must be free and unobstructed. Compressed air should be used to blow them out.

Inspection

1 - Inspect drive pinion for wear and damge, if necessary replace drive pinion and ring gear as a pair. (Note matching number).

2 - Check condition of roller bearing and double row ball bearing; replace if necessary.

3 - Check gears for 3rd and 4th speeds for wear and damage; replace as necessary, but only in pairs.

4 - Check guide sleeve, selector ring, and engaging pins for wear and damage and renew as necessary. The engaging pins should have no undue radial clearance in the grooves of the guide sleeve to obviate a slipping out of the gears.

5 - Examine sliding gear for 1st and 2nd speeds for wear and damage; replace if necessary. If excessive wear or damage is found, also check gears on main drive shaft. Replace the main drive shaft, should it be necessary.

6 - Check 4th gear bush, spacer, and shims for wear and replace as necessary.

Assembly

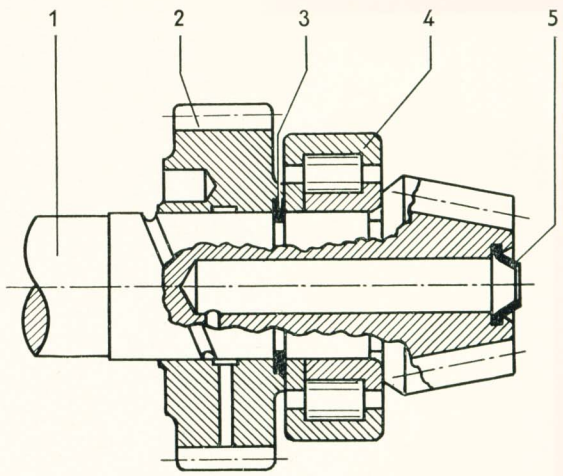
This is a reversal of the disassembly procedure, but the following points should be observed:

1 - The roller bearing inner race should be heated in an oil bath to 90 °C (194 °F) before pressing it in position.

Important!
Be sure the roller bearing is a press fit on the drive pinion. A loose fit necessitates a replacement of the worn parts.

Fit roller bearing with friction washer toward third speed gear. Install roller bearing lockring.

Guide the retaining ring with one hand while expanding it with the pliers to allow it to be slipped in position. Do not overstrain the ring. Check if the ring is correctly bedding at the bottom of the ring groove. Replace ring if overstrained.



1 - Drive pinion
2 - Gear for 3rd speed
3 - Retaining ring
4 - Roller bearing
5 - Oil baffle disc

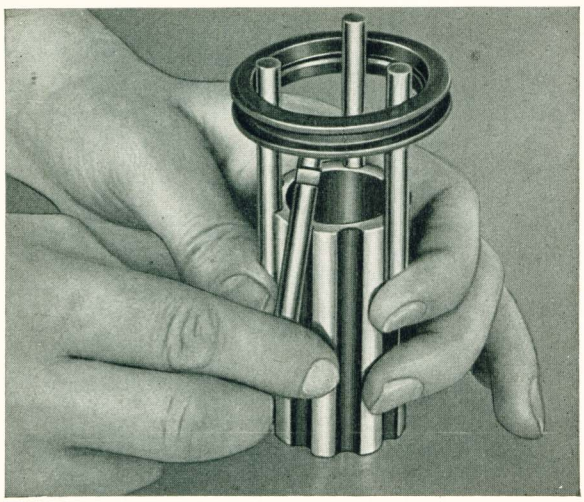
2 - Install 3rd speed gear.

3 - Install guide sleeve retaining ring.

Note:

Under certain circumstances it is possible that the required 3rd speed gear end play cannot be obtained. To reach the correct end play when assembling the drive pinion, a guide sleeve retaining ring of 2.4 mm (0.09″) thickness has been introduced in addition to the retaining ring of 2 mm (0.08″) dia. The new retaining ring can be recognized by the flat faces, whereas the earlier ring has a round cross section. When the drive pinion is assembled, the roller bearing and the 4th speed gear are to be pushed simultaneously towards the 3rd gear. If the end play at the 3rd gear is below the low limit, the guide sleeve retaining ring of 2 mm (0.08″) thickness should be replaced by the thicker ring (2.4 mm/0.09″).

4 - Assemble guide sleeve, engaging pins, and selector ring. Hold guide sleeve in one hand so that the internal splines are at the bottom. Fit three engaging pins to the guide sleeve at an equal distance from one another and slide selector ring over them so that the internal shoulder faces downward. Fit the six remaining pins.



Note:

From Chassis No. 1167145 shifting pins that are eccentric at the ends engaging the 4th gear are being used on all standard transmissions.

Attention!

The new pins can be incorporated in earlier transmissions as and when the opportunity offers; they constitute a greater protection against a slipping out of the 4th gear.

5 - Slide guide sleeve on the drive pinion taking care that the plain portion of the guide sleeve hole is at the front.

6 - Place sliding gear for 1st and 2nd speeds on drive pinion so that the larger diameter is toward the selector ring.

7 - Install 4th speed gear and bush.

8 - The radial play and the end play of the 4th speed gear should, if possible, be at the lower tolerance limit:

Lower limit of radial play 0.04 mm/0.0016″.

Lower limit of end play 0.25 mm/0.0098″.

9 - Install shims on drive pinion as required to obtain the correct axial adjustment. Shims in the thicknesses 0.2 mm and 0.3 mm (0.008″ and 0.012″) are available for this purpose so that the axial adjustment can be corrected in units of 0.1 of a millimeter.

a - When replacing parts of the drive pinion assembly which do not affect the axial adjustment, the total thickness of the shims should not be altered to insure a correct meshing of pinion and ring gear.

b - When replacing drive pinion or other parts which affect the axial adjustment, the proper amount of shims must be determined once more.

The standard thickness of the total shims is 0.7 mm (0.275″). The plus or minus marking on the drive pinion face must be considered in this connection.

Example:

Standard thickness of shims	0.7 mm
Axial tolerance discrepancy —0.18 mm. This value is to be raised to the next tenth of a millimeter, namely	— 0.2 mm
Total thickness of shims required	0.5 mm

The total thickness of shims should be checked by the test mandrel VW 289 and an impression of the drive pinion tooth bearing when positioning drive pinion and ring gear.

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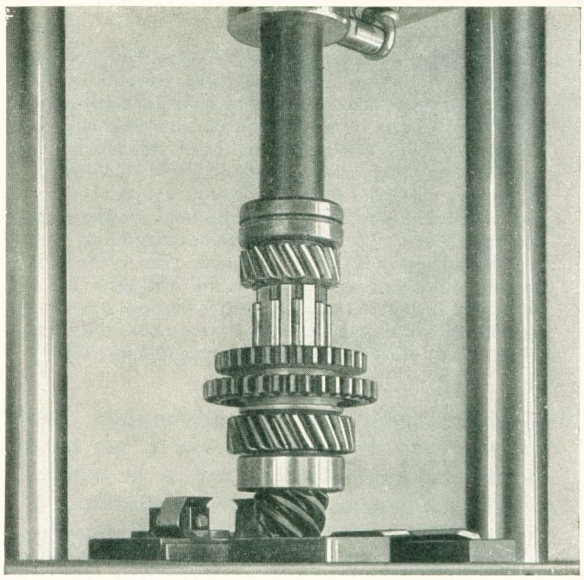
10 - Press double row ball bearing in position, using Repair Press VW 400 in conjunction with VW 402 and VW 416. The channel machined in the outer race of the bearing for fitting the balls must face the drive pinion nut.

11 - Tighten drive pinion nut with torque wrench VW 118/30 and socket VW 162 as detailed below:

First tighten nut to a torque of 15 mkg (108 ft. lbs.) and loosen it again. Then tighten to a torque of between 6 and 7 mkg (45 and 50 ft. lbs.) and continue to turn the nut until the next slot is in line with one of the two holes for the cotter pin.

12 - Fit cotter pin not before the axial adjustment of the pinion has been rechecked.



The section "Rear Axle and Synchromesh Transmission" contains instructions on:

Removing and Installing Rear Axle

Disassembly and Assembly of Rear Axle

Rear Wheel Bearing Seat and Axle Tubes

Final Drive

Gear Control

Rear Suspension

1 - VW Special Service Tools

VW 112	Special Wrench 36 mm with Guide Plate
VW 114	T-Wrench 8 mm Square Socket
VW 161 a	Circlip Pliers
VW 163 a	36 mm Socket
VW 202	Extractor
VW 202 b	Extractor Hooks
VW 202 h	Distance Sleeve
VW 222	Starter Shaft Bush Pilot Drift
VW 228 a	Starter Shaft Bush Extractor
VW 230	Rear Axle Shaft Oil Seal Installing Tool
VW 240 a	Driver
VW 241 a	Ball Bearing Extractor
VW 245 a	Protactor
VW 246	Not-Go Plug Gage
VW 285	Differential Ball Bearing Gage (Required by large workshops and for unit reconditioning only)
VW 287	Differential Housing Gage
VW 288 b	Backlash Gage
VW 289 b	Transmission Case Mandrel
VW 290 a	Ball Bearing Installing Tool
VW 290 b	Ball Bearing Removing Tool
VW 291 b	Main Drive Shaft Oil Seal Installing Tool
VW 307	Fixture
VW 308	Stand
VW 314	Fixture
VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 402	Thrust Plate
VW 405	Punch with V-Block
VW 406	V-Blocks (two)
VW 407	Punch
VW 408	Punch
VW 409	Punch
VW 410	Punch
VW 411	Punch
VW 412	Thrust Disc
VW 415	Tube, 75 mm dia.
VW 416	Tube, 38 mm dia.
VW 419	Tube, 32 mm dia.
VW 420	Tube, 28 mm dia.
VW 421	Tube, 28 mm dia.
VW 430	Thrust Pad (Bronze)
VW 431	Thrust Pad, 16.5/28 mm dia.
VW 433	Thrust Pad
VW 436	Guide Pin (Tapered)
VW 437	Guide Pin (Tapered)
VW 438	Guide Pin (Cylindrical)
VW 439	Guide Pin (Shouldered)
VW 442	Thrust Pad
VW 449 a	Toothed Thrust Ring
VW 449 b	Toothed Thrust Ring

2 - VW Workshop Equipment for Local Manufacture

VW 605	Gantry Crane
VW 633	Trestle
VW 655	Torsion Bar Tensioner
VW 656	Spring Plate Installing Tool
VW 664	Differential Housing Holding Fixture

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3 - Normal Hand Tools

Combination pliers
Cold Chisel
Prick punch (center punch)
Pin punch, 4 mm
Mechanic's hammer, 300 grams
Mechanic's hammer, 500 grams
Rubber mallet, 85 x 50 mm
Triangular scraper
Flat scraper
Flat file, 180 mm in length
Half-round file, 180 mm in length
Socket wrench, 11 mm
Socket wrench, 12 mm
Socket wrench, 13 mm
Socket wrench, 14 mm
Socket wrench, 15 mm
Socket wrench, 17 mm
Socket wrench, 19 mm
Open-end wrench, 14 mm
Open-end wrench, 17 mm
Open-end wrench, 19 mm
Box wrench, 14 mm
Box wrench, 15 mm
Box wrench, 17 mm
Box wrench, 19 mm
Box wrench, 27 mm
Wire brush
Oil-can
Can for derusting fluid
Grease container
Scratch awl
Dial indicator
Set of feeler gages, 0.1—0.5 mm
Micrometer Caliper, 0—25 mm
Micrometer Caliper, 25—50 mm
Micrometer Caliper, 50—75 mm
Caliper square, 300 mm in length, measuring 1/50 mm
Depth gage, 300 mm in length, measuring 1/50 mm
Straight edge, 1000 mm in length
Dial gage for checking 18—100 mm inside diameters, measuring 1/1000 mm
Tap M 6
Tap M 8
Tap M 10
Tap M 12 x 1.5
Die stock, size 1
Die Stock, size 2
Die M 6
Die M 8
Die M 10
Die M 12 x 1.5
Tap wrench, size 1, adjustable
Tap wrench, size 2, adjustable
Torque wrench, 0—30 mkg (217 ft. lbs.)
Inspection lamp with cable and plug
Electric drill
Oil funnel

4 - Supplementary Workshop Equipment

Run-out testing device
Track (tread) gage
Wheel alignment service equipment